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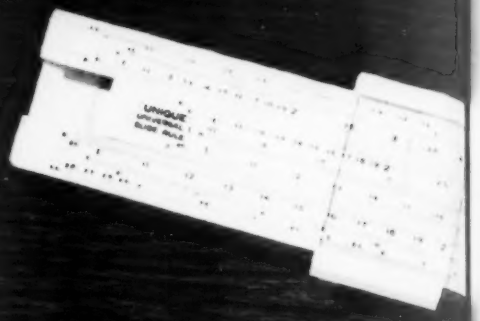

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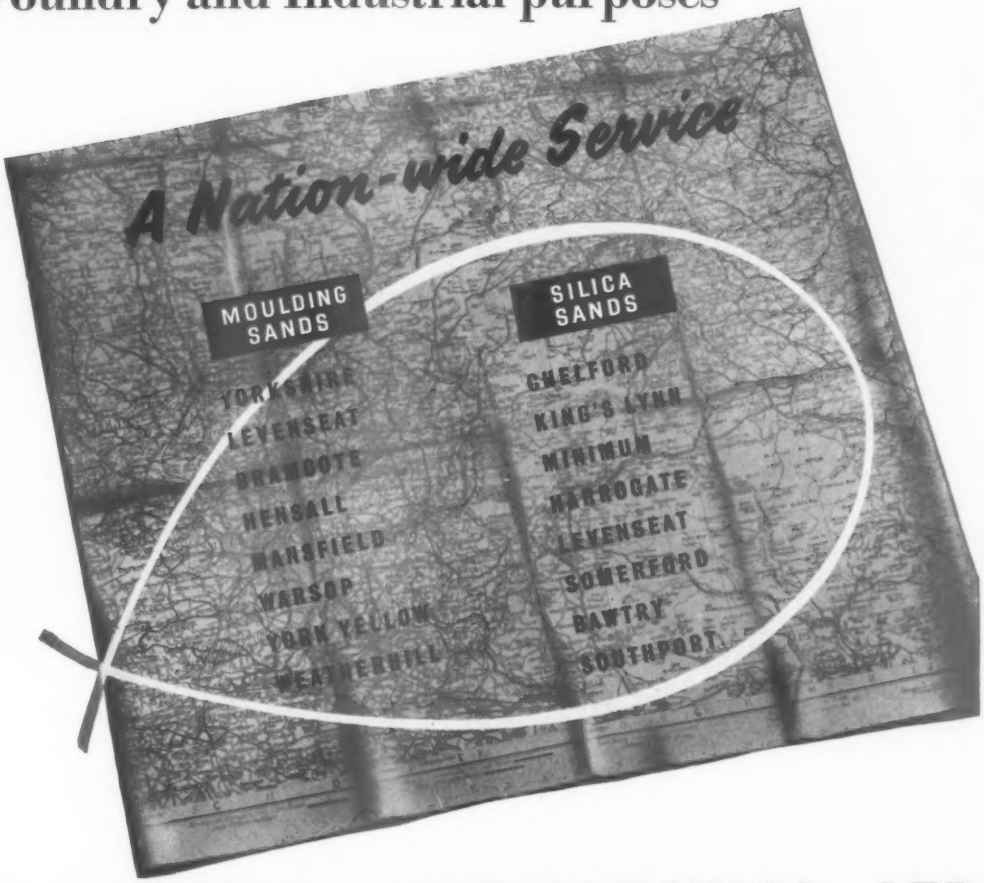

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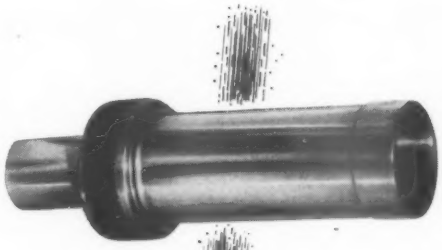

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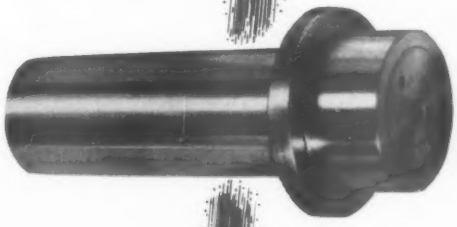

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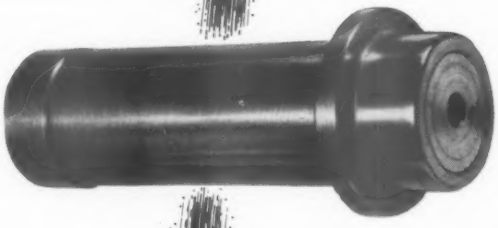

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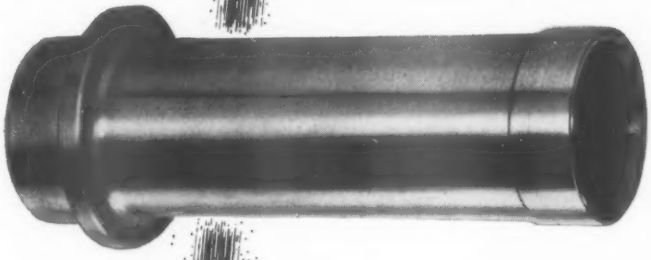

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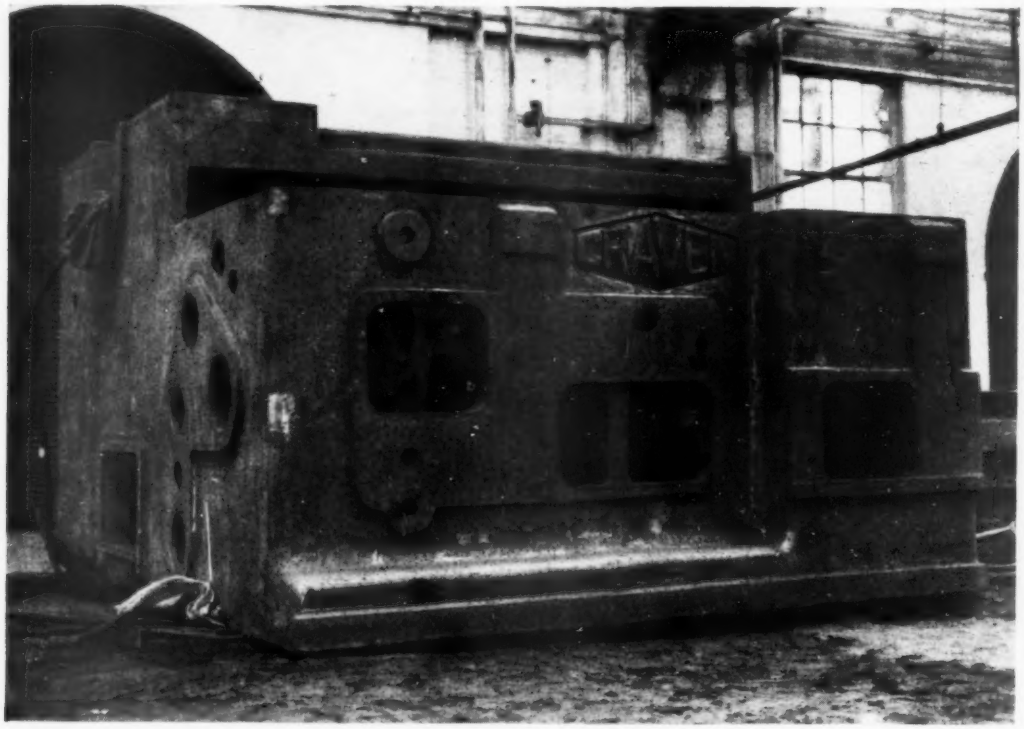

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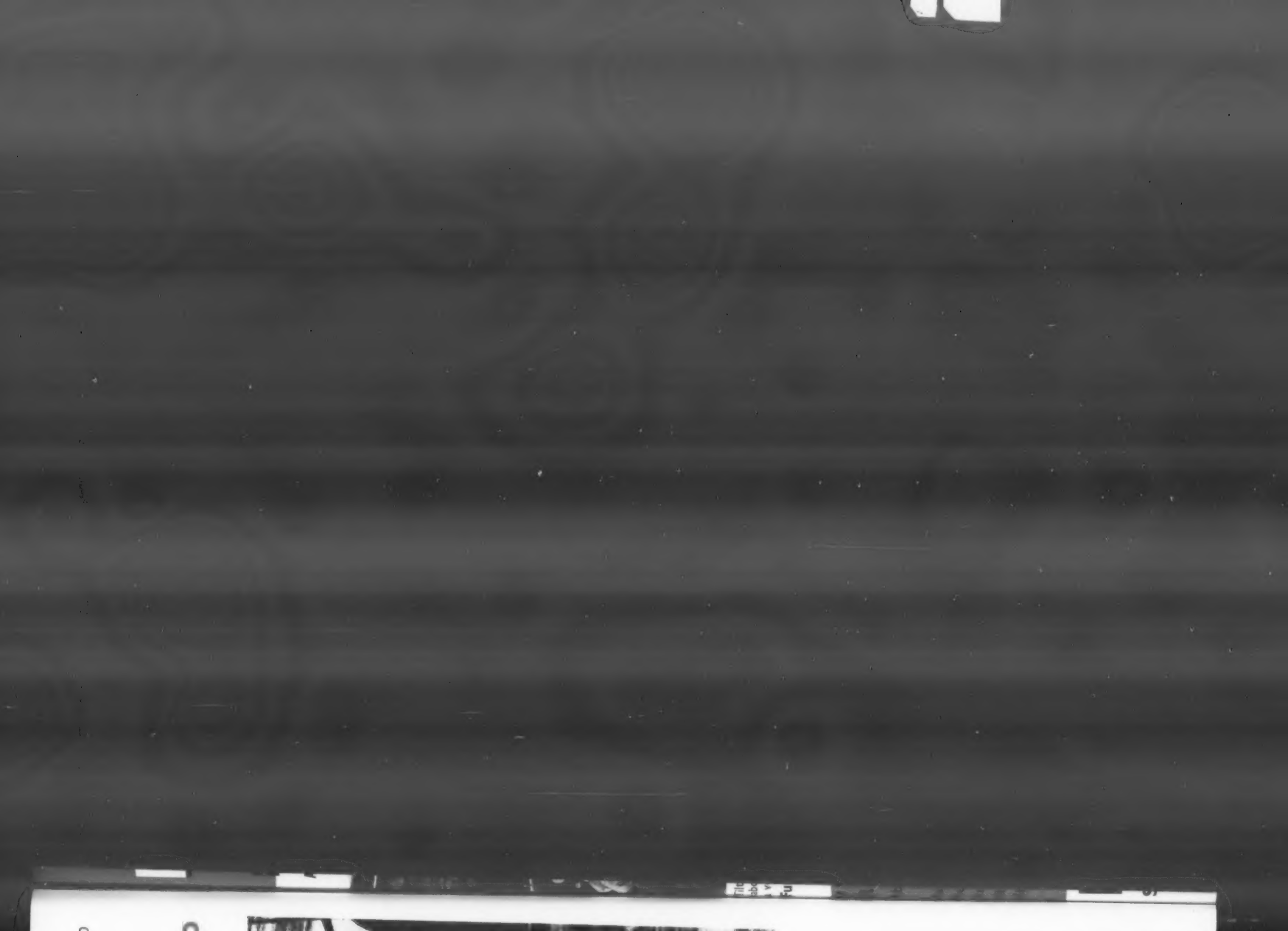

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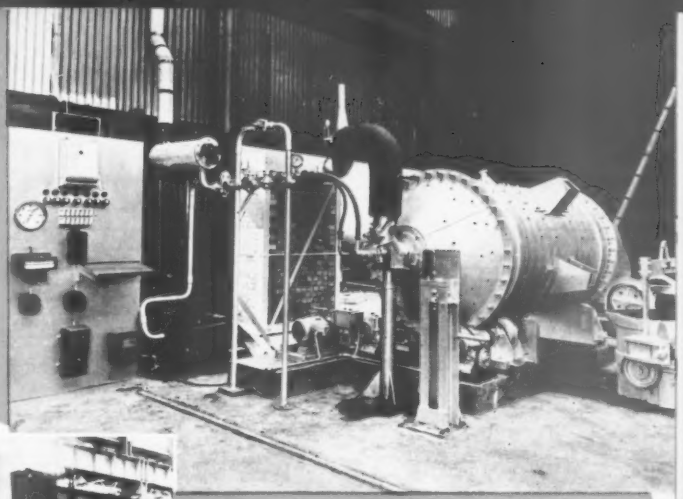

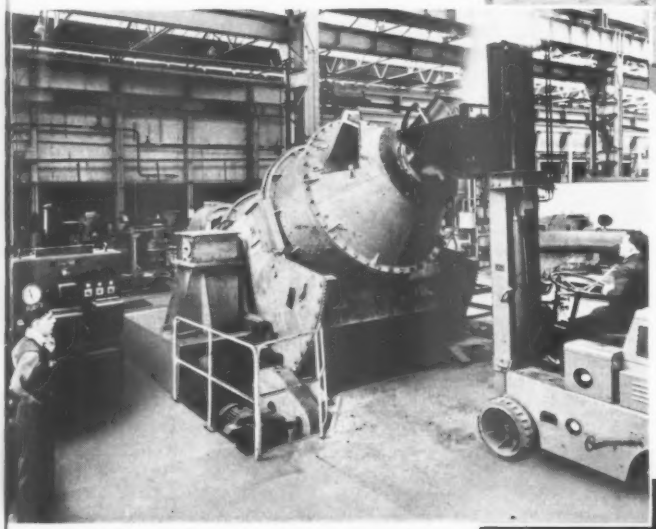

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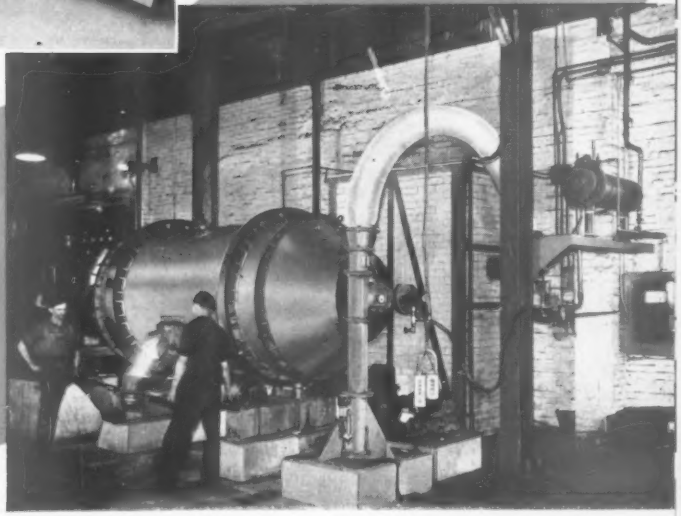

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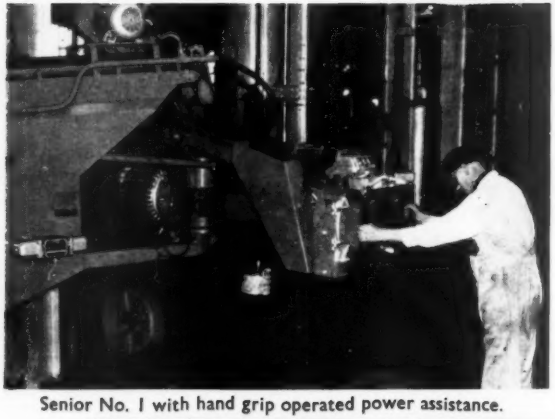

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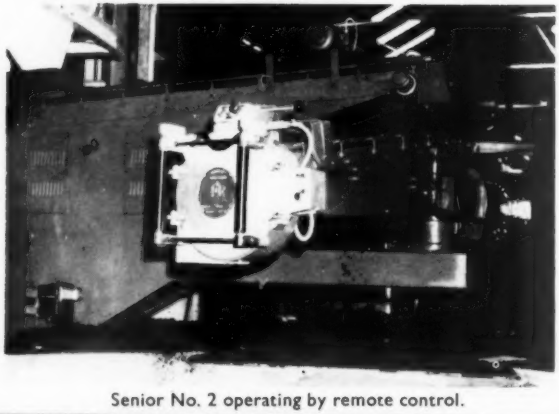

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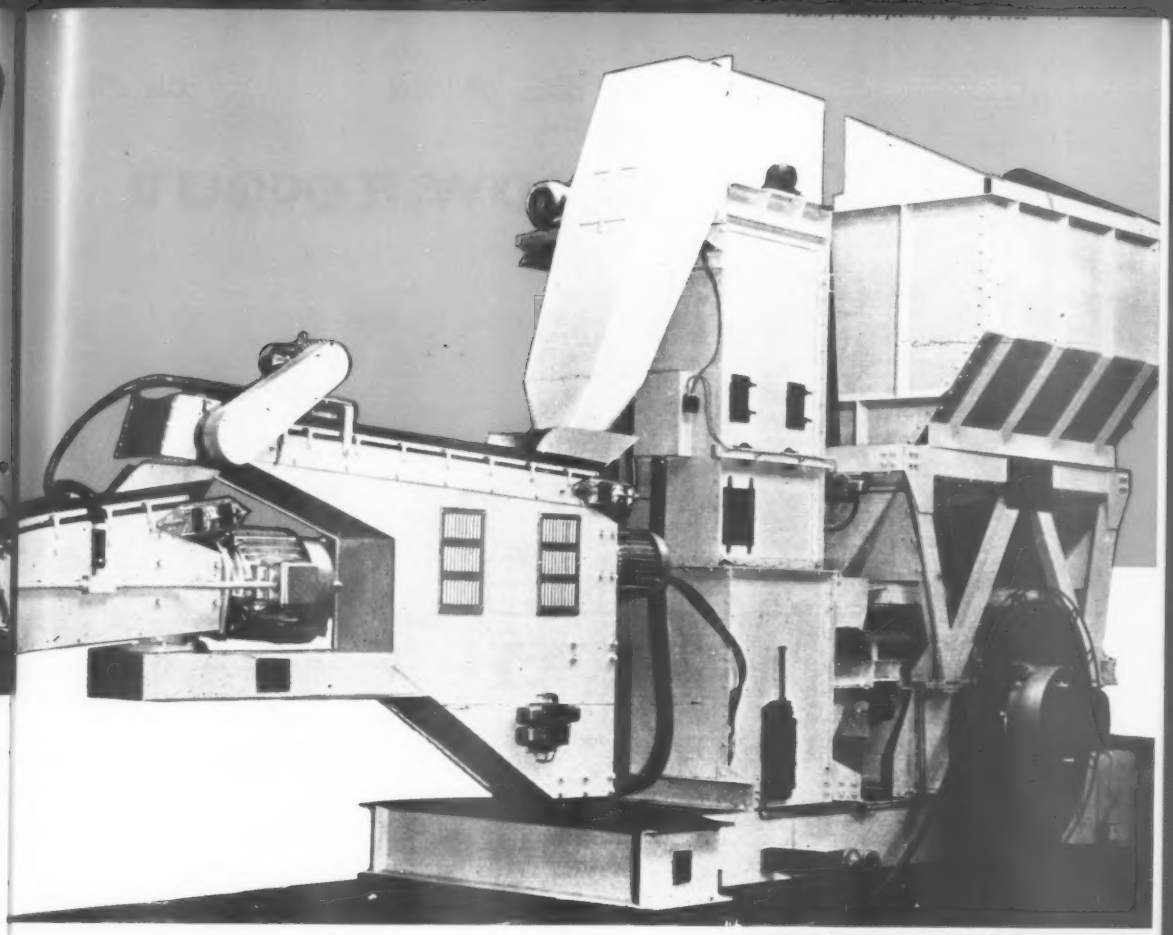

Mobile No. 4 Sandrammer, 15ft. radius, shown above has Patented 24in. dia. "Turbo-Ram" head illustrated on right. Feed Unit includes 7½-ton drop-bottom hopper and spare hopper. Fully automatic control from head. Output up to 2,000 lbs./min. "Turbo-Ram" head is also available on Stationary No. 4 and No. 3 Sandrammer with 10ft. radius.

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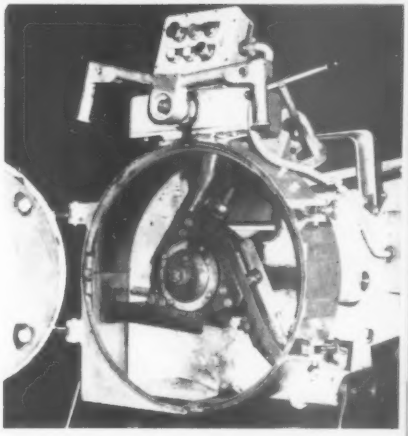

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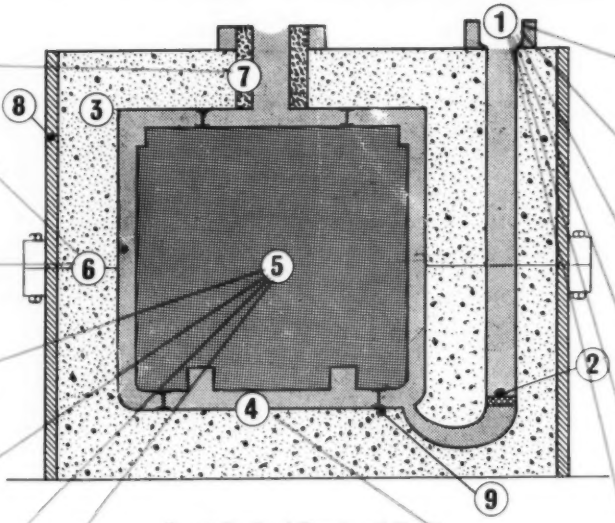

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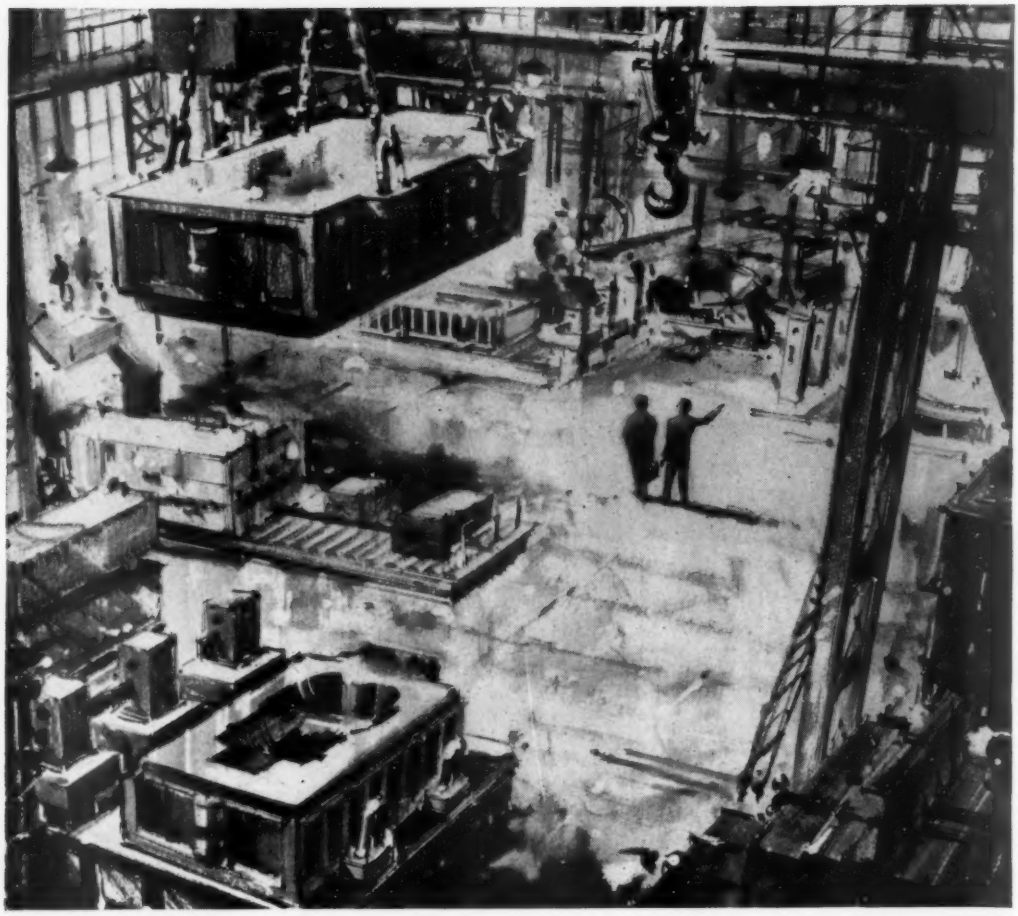

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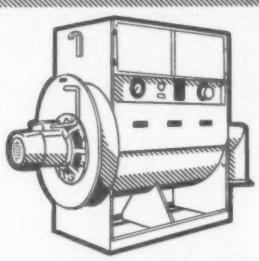

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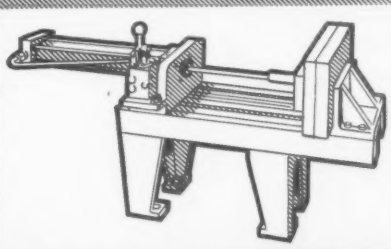

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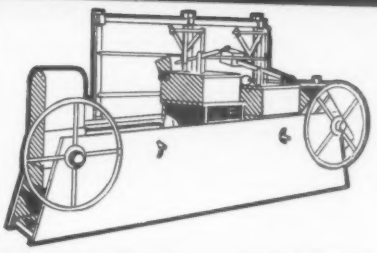

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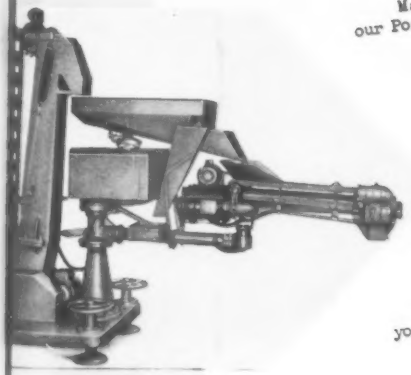

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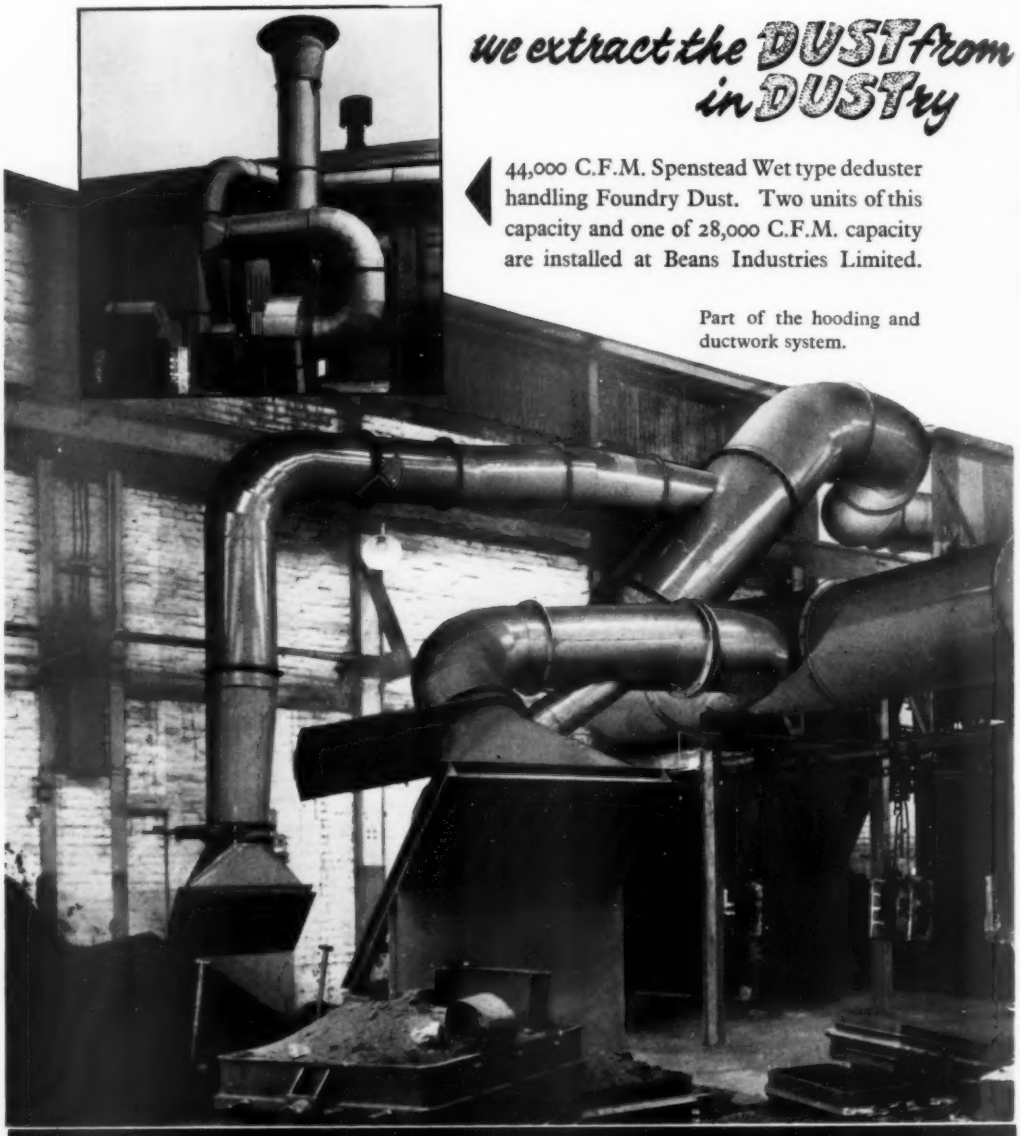

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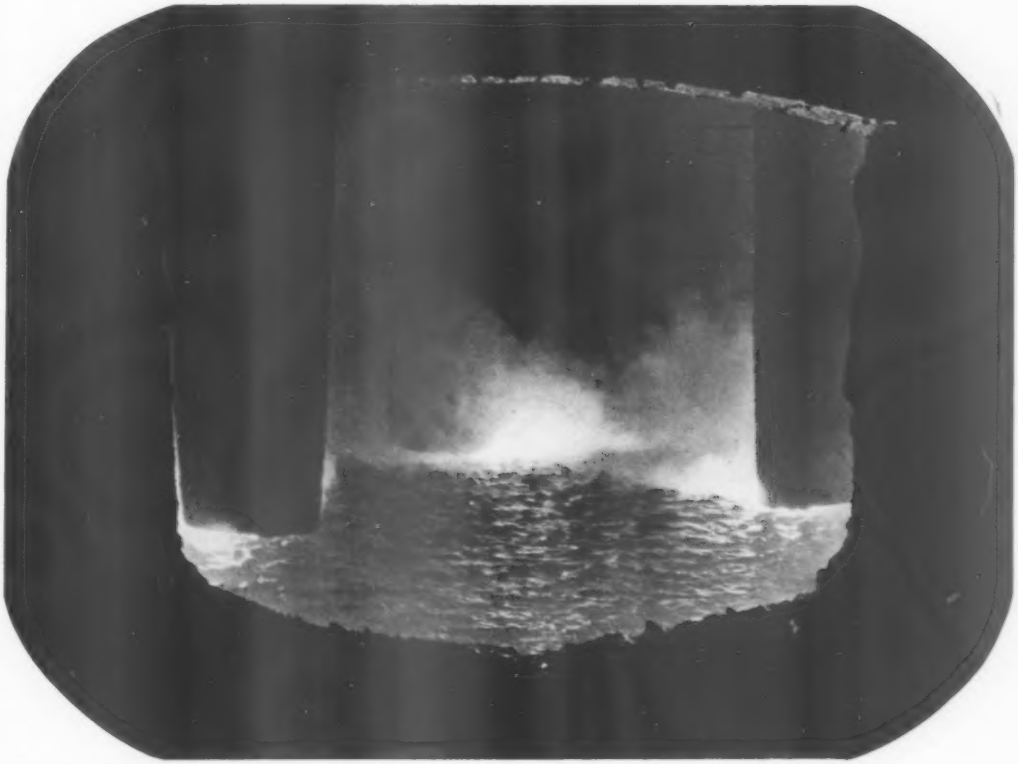

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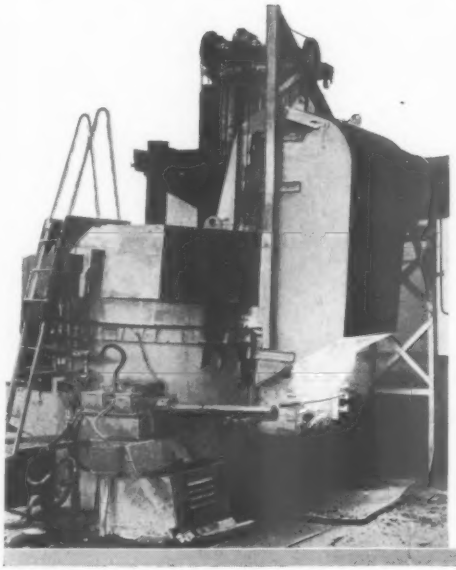

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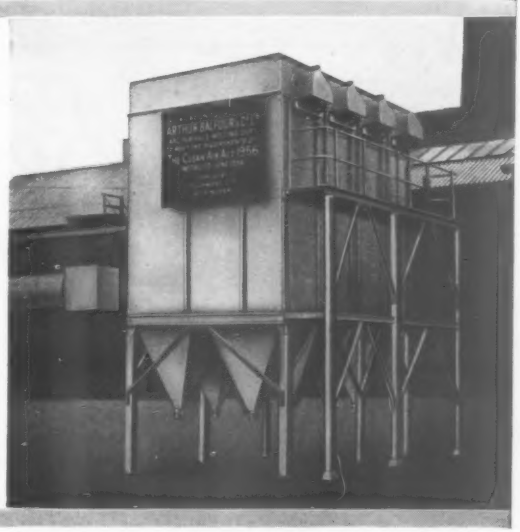

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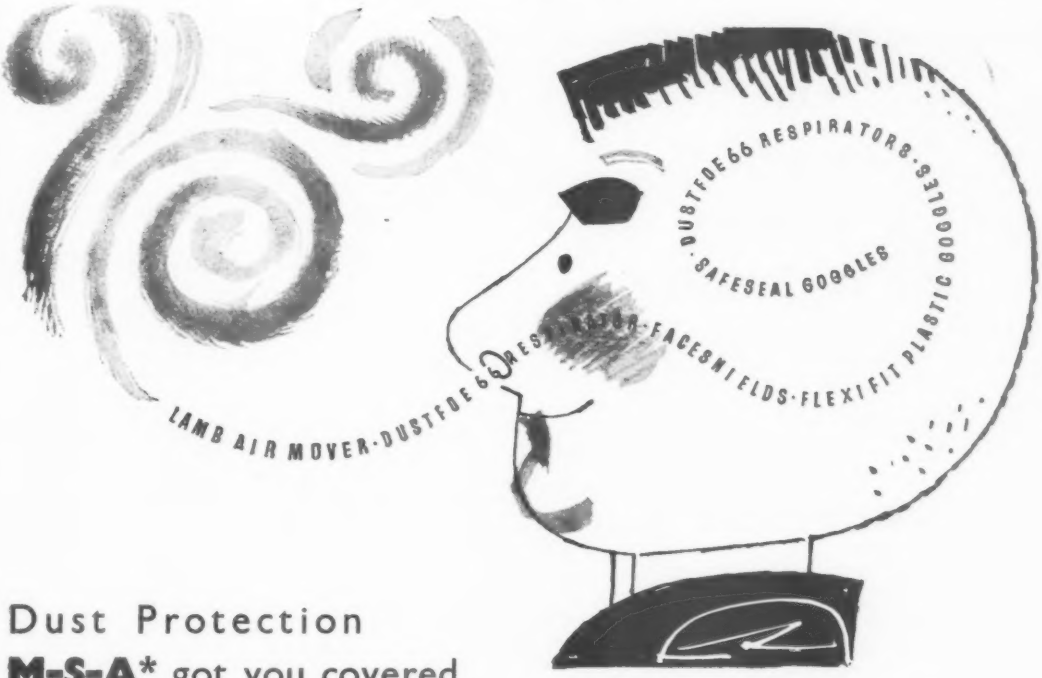

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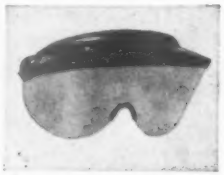

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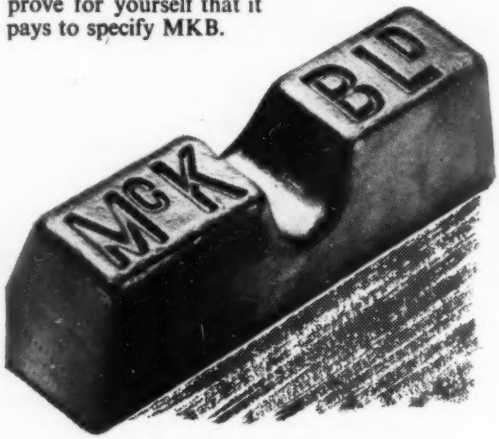

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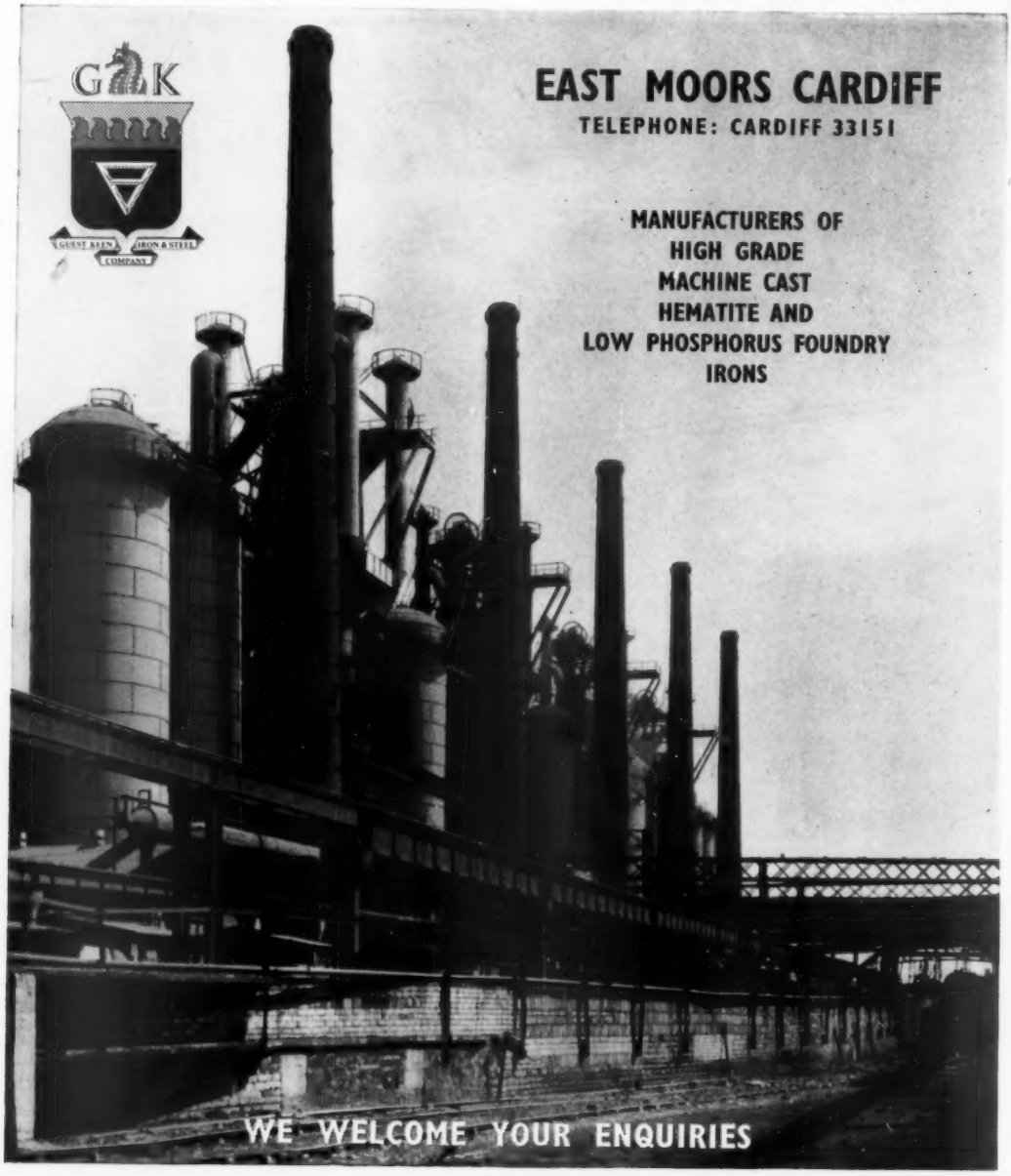

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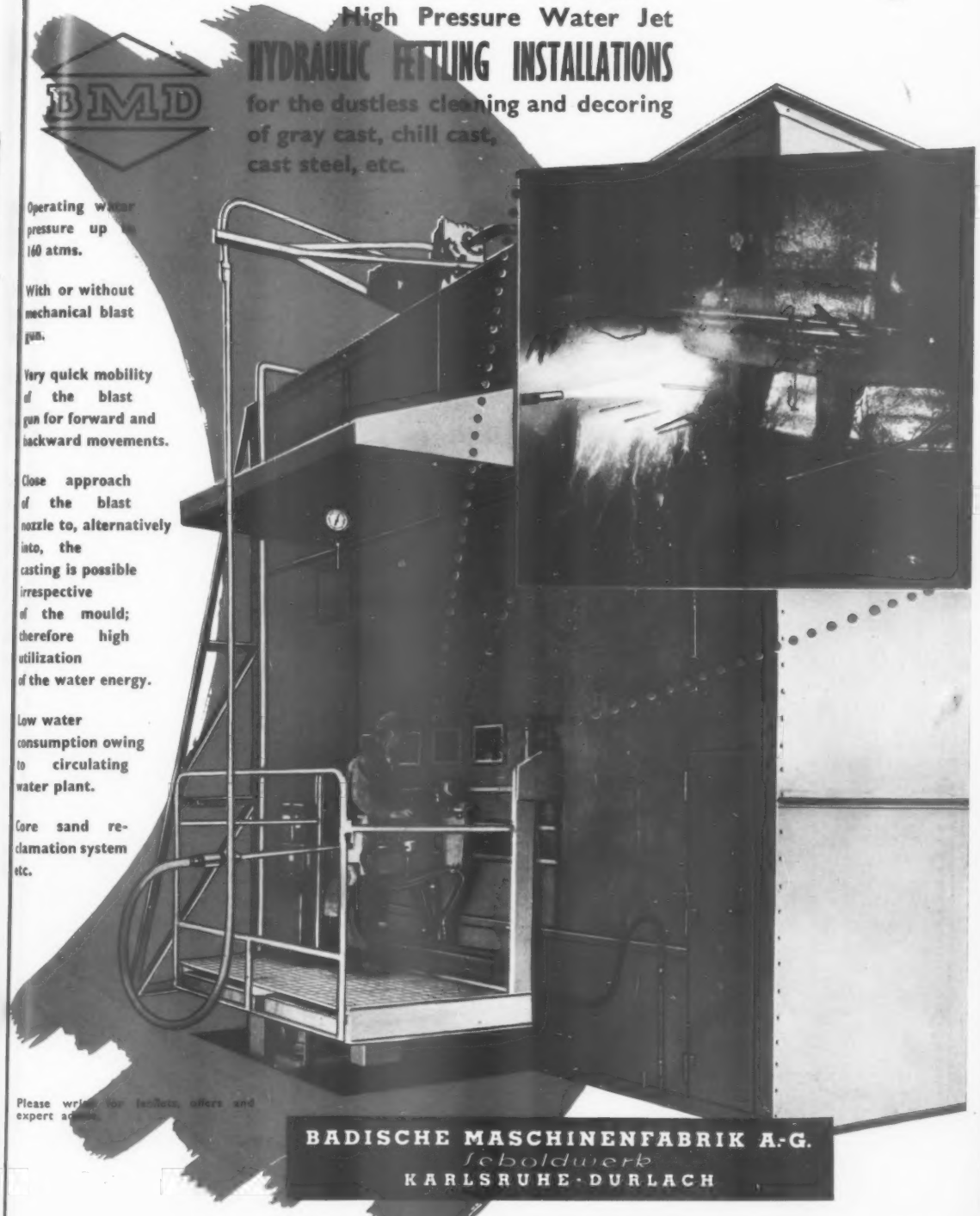

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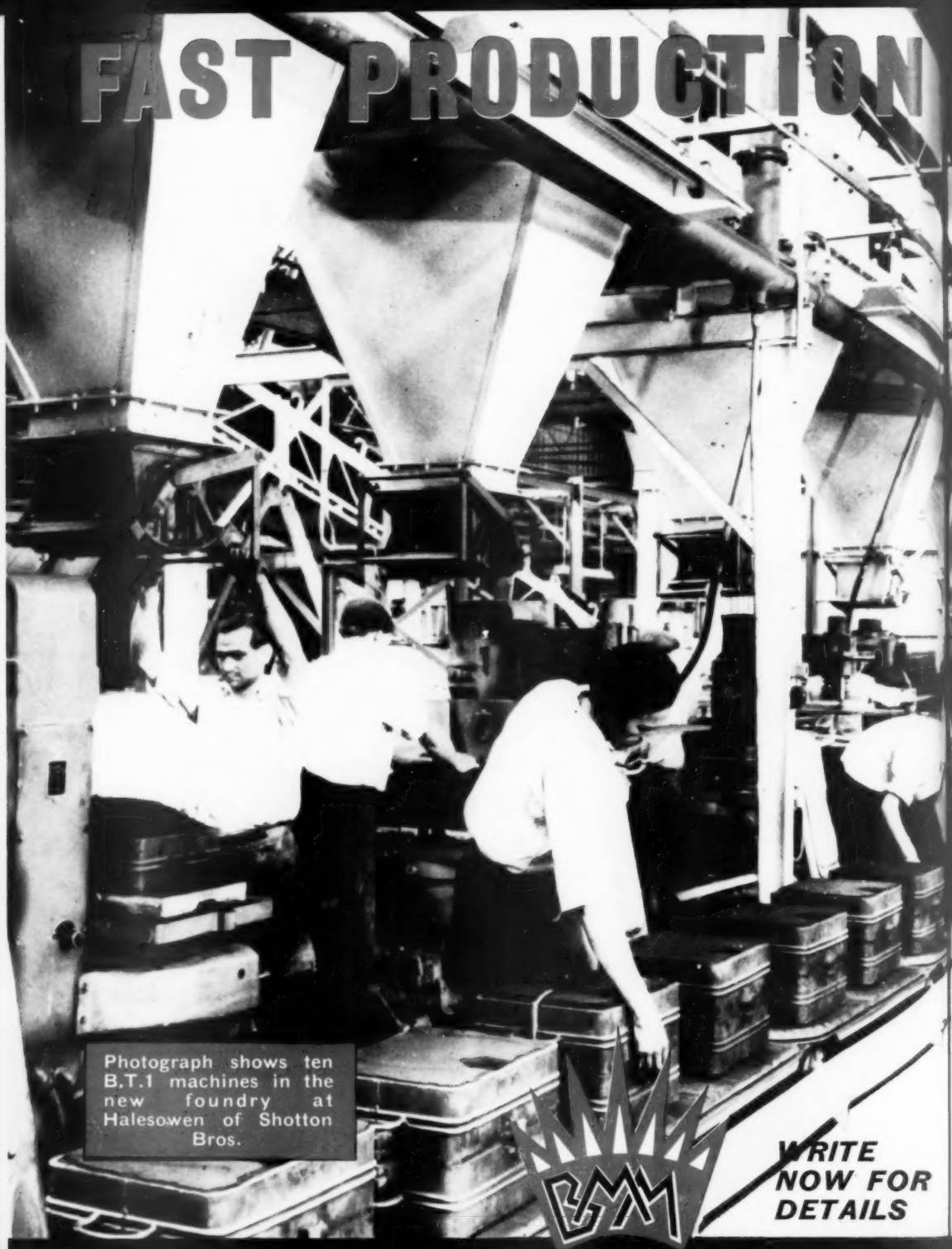

Photograph shows ten B.T.1 machines in the new foundry at Halesowen of Shotton Bros.

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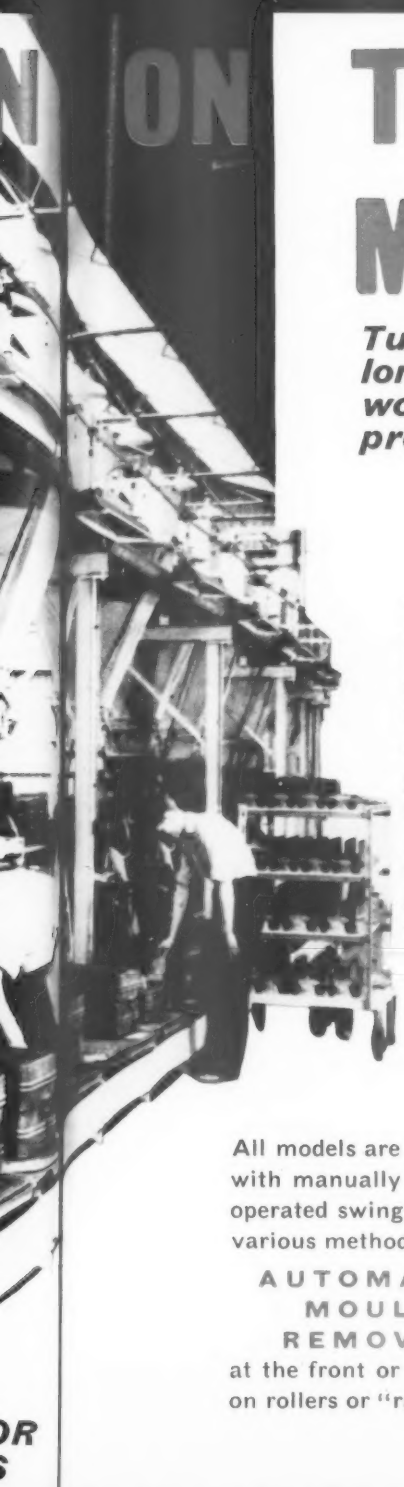

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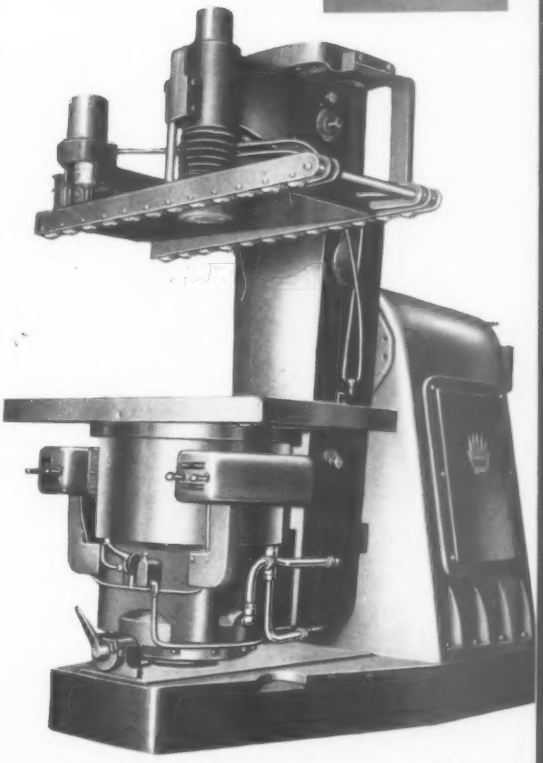

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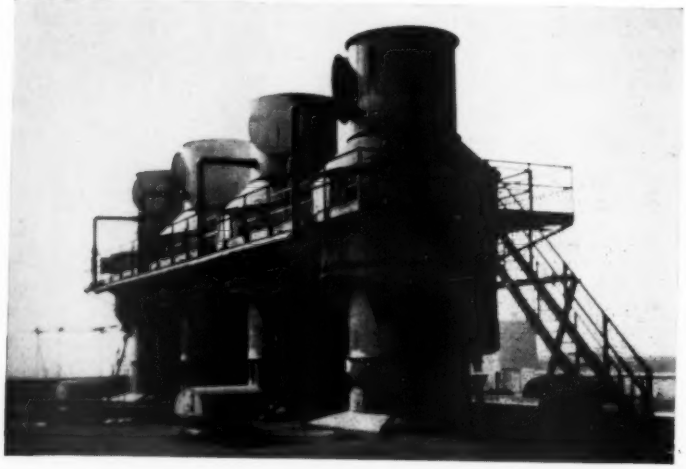

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Photo completely untouched taken during normal operating conditions.

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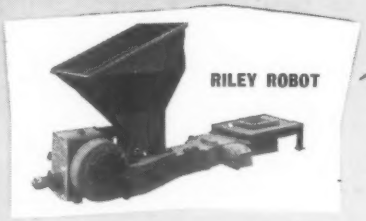

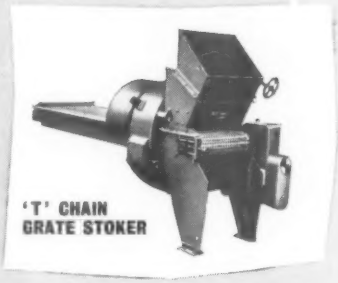

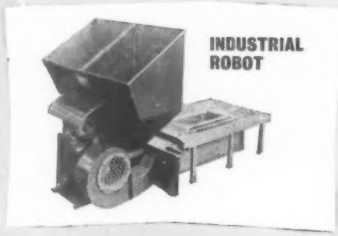

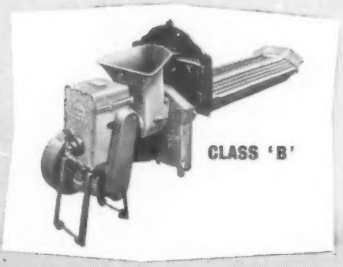

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FOUNDRY TRADE JOURNAL

Vol. 108 April 7, 1960 No. 2261

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PRINCIPAL CONTENTS

PAGE

Link-Belt's New Malleable-iron Foundry

Account of operations at a new mechanized malleable-iron foundry built by Link-Belt Company, of America, at Ewart, Indianapolis, for the production of chain-link gears, sprockets, etc., and other malleable castings needed in their range of mechanical-handling and power-transmission equipment 419

Vitreous-enamelled Cast-iron

By J. R. Park

The author considers to what extent defects in enamelled surfaces are due to the casting itself, the surface preparation, the enamelling process and the enamel itself 427

Investment Casting Experience

By N. Walker

The author describes problems encountered when making and using preformed refractory cores, and deals also with the effect of nitrogen content on the casting behaviour of a nickel/chromium alloy 431

La nouvelle Usine de Fonte malléable de "Link-Belt."
Compte-rendu des opérations à la nouvelle fonderie mécanisée construite par la Link-Belt Cie, à Ewart, Indianapolis, en Amérique, pour la production d'engrenages à chaînes articulées, roues à chaînes etc. et d'autres coulées en fonte malléable requises dans le domaine de l'équipement de manutention mécanique et de matériel de transmission de puissance 419

Fonte de Moulage émaillée. Par J. R. Park.
L'auteur considère jusqu'à quel point les défauts des surfaces émaillées sont dûs au moulage lui-même, à la préparation de la surface, au procédé d'émaillage et à l'émaillage en lui-même. 427

Experience fournie par les Coulées de Précision à la Cire perdue. Par N. Walker.
L'auteur décrit les problèmes qui se posent pendant la fabrication et l'usage des noyaux préfaconnés en matériaux réfractaires, et traite aussi de l'effet que la teneur en azote produit sur le comportement en coulage d'un alliage de nickel-chrome 431

Die neue Tempergiesserei der Firma Link-Belt.
Eine Beschreibung der Arbeitsvorgänge in der neuen mechanisierten Tempergiesserei, welche von der Link-Belt Company, in Ewart (Indianapolis, Vereinigte Staaten) errichtet wurde um Kettengetriebe, Kettenräder usw., sowie andere Tempergussteile herzustellen, welche die Firma in ihrem Arbeitsgebiete der Fördermittel und Kraftübertragungsmittel benötigt. 419

Emailliertes Gusseisen. Von J. R. Park.
Der Verfasser zieht in Betracht in welchem Ausmasse Fehler in emaillierten Oberflächen auf den Guss als solchen, seine Oberflächenbehandlung, das Emaillierungsverfahren oder das verwendete Email selbst, zurückzuführen sind. 427

Bei der Herstellung von Feinguss gemachte Erfahrungen. Von N. Walker.
Der Verfasser beschreibt Probleme, denen er begegnete, als vorgeformte Kerne aus feuerfestem Material hergestellt und verwendet wurden. Er behandelt weiters den Einfluss eines Stickstoffgehaltes auf das Verhalten einer Nickel-Chromlegierung beim Vergiessen 431

Features, News, Commercial Information and Statistics

Leader: Education for Management 417
Dilworth & Carr Long-service Awards 418
Dinner: Institute of Metals 418
"Gas at Work" Exhibition in Harrogate 426
Midlands comment on Scrap 430
United Steel's Sixth "Responsibility" Conference 430
British Exhibits at AFS Show 430
Forthcoming Events 437
Notes from the Branches 438
Personal 440
News in Brief 441
Raw Material Markets 444
Current Prices of Iron, Steel and Non-ferrous Metals 446
American Letter 450
Company News 452
Pig-iron and Steel Production 454

MODERN PLANT by

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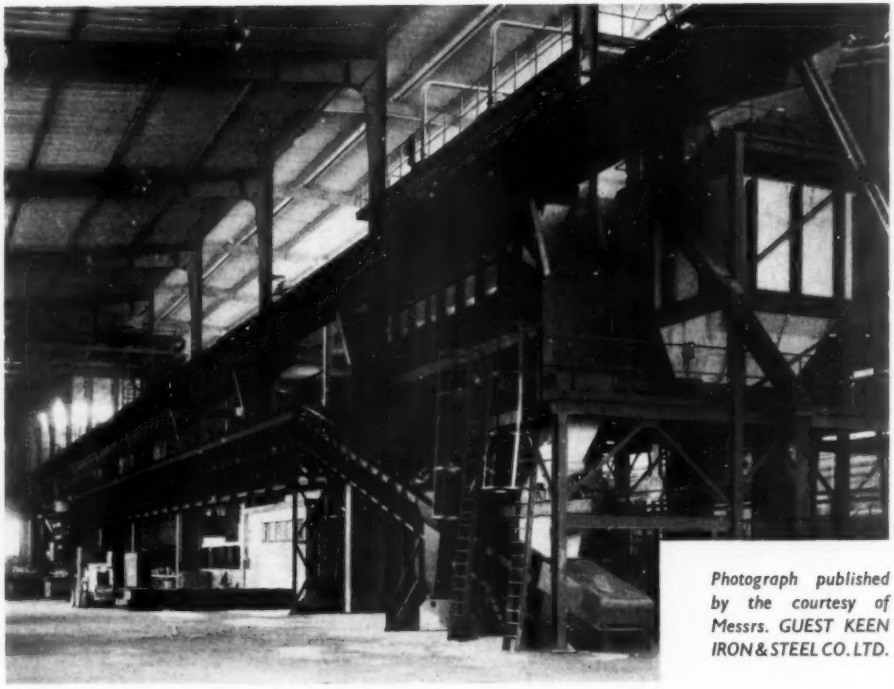

Photograph published by the courtesy of Messrs. GUEST KEEN IRON & STEEL CO. LTD.

Photograph shows mixed sand vibrating screen, storage hopper with belt feeder, system aerator, and conveyor (with overband magnet), for distribution of prepared sand to a large sand slinger (travelling type).

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FOUNDRY
TRADE JOURNAL
Vol. 108 April 7, 1960 No. 2261

Education for Management

Sir David Eccles, Minister of Education, has wisely decided to " spring clean " the existing situation for the handling of courses of instruction in management studies. The changes are that there is to be: (1) A new diploma in management studies; (2) an Advisory Council on management education, and (3) two new " National Certificates in Business Studies." About 13 years ago, some sort of order was achieved through the work of the Urwick Committee on Education for Management, but with the passage of time, this was deemed to be inadequate and called for reorganization. The system, however, has so progressed that there are no fewer than 300 diplomas awarded yearly. The Minister, at a Press conference, recently expressed the hope that full-time residential courses would be developed, which would supplement the proposed course of study, which might be full-time (up to one year) or part-time (three years) or a mixture of the two. It was put forward that these courses should be held in the colleges of advanced technology or at the major regional colleges.

We were interested in the statement that management education had been too closely associated with economics and commerce to the relative neglect of the social sciences, such as sociology and psychology. It is pertinent to ask whether the last subject can—to use an Irishism—be taught objectively, for personal contact with industrial management has indicated that good managers are inherently good psychologists. They instantaneously realize any weakness in argument or approach by a workman or his spokesman, and whilst never giving offence, win their case. What they do or say is only applicable to a given set of circumstances and cannot be used as a textbook example. As occasions demand, a manager may use appeal to " sportsmanship," affect an attitude of personal affront, envisage *cherchez la femme*, or apply any other of a dozen or so approaches to resolve awkward industrial situations.

For some years, there have been a number of management courses of varying duration and at not inexpensive fees. Many foundry executives have benefited from participation, as there is a widespread belief that the weakest member of the foundry executive team is the man connecting the cost of production and the selling price. Thus, our industry can expect to gain from the proposed radical changes in management education. They should at least produce men whose training will be such as to enable them to increase the attenuated gap between costs and selling prices.

Dilworth & Carr Long-service Awards

On Wednesday of last week, employees and directors of Dilworth & Carr, Limited, ironfounders and engineers of Preston, were joined by representatives of the parent organization (United Glass, Limited), the technical and daily Press, and union representatives for the presentation of a number of long-service awards. The ceremony was held in the works canteen. The proceedings were opened by the works director, Mr. R. Greenwood, who, after welcoming guests, introduced Mr. L. A. Elgood, O.B.E., M.C., J.P., chairman of United Glass, Limited, who presented the awards, which chiefly took the form of inscribed silver tankards and badges. They were made—on the basis of a minimum of 25 years' service—to the following: Mr. L. R. Smith (39), director; Mr. H. Hancox (38), patternshop manager; Mr. R. James (38), moulder; Mr. T. Parkinson (35), despatch clerk; Mr. R. Guymer (35), now a director of United Glass, Limited; Mr. C. Green (34), storekeeper; Mr. R. Farnworth (32), machinist; Mr. J. Aspden (30), foreman moulder; Mr. J. J. Cooper (27), chargehand patternmaker; Miss F. I. Byron (27), of the office staff; Mr. A. Stephenson (26), fitter, and Mr. W. Marsden (26) machinist. (The figures in parentheses indicate actual periods of service). In handing over the awards, Mr. Elgood mentioned how gratifying it was to find such a comparatively large number of long-service employees in a firm, the total staff of which to-day only approximated 200. He thanked them all for loyal and efficient service over the period and indicated that the firm was destined for continuous expansion henceforward, in its association with the United Glass group. Mr. T. Parkinson acknowledged the awards on behalf of his fellow recipients.

New Foundry Section Opened

Earlier that day, some of the guests had assembled in the foundry to watch Mr. Elgood press a series of buttons to set in motion a new mechanized section. This small unit had been "tailored" by Foundry Mechanisations (Baillot), Limited, to occupy (along with its own separate melting-plant) a corner in the existing foundry. It is intended for the repetition production—from two moulding machines—of glass-bottle moulds and components for bottle-making machinery. (An account of the layout and equipment chosen for this unit will appear in the JOURNAL shortly).

The Dilworth & Carr foundry has been established since the early years of the century and produces also large pipe-specials for power-stations, and similar heavy castings, on a jobbing basis for a number of prominent electrical and construction firms. The ratio of products for outside firms and for United Glass is about 40:60. Also operated by the company are fully equipped machine- and assembly-shops, a specialty being made of complete mechanized glass-bottle manufacturing plant.

THE KEEL has been laid at the Merwede shipyard, Hardinxveld, Holland, of the new Oranje Line passenger/cargo liner Prinses Margriet, a sistership of the Prinses Irene which is the line's 8,533 gross tons flagship. The new vessel will be driven by a 10-cylinder M.A.N. motor of 8,600 b.p.h., giving her a speed of 17 knots. She will have luxury air-conditioned accommodation for 110 passengers in single and double cabins. The Prinses Margriet is expected to be ready for launching in the second half of this year, and to enter service next year.

Dinner

INSTITUTE OF METALS

The annual dinner of the Institute of Metals was held last Thursday at Grosvenor House, London, when almost 1,000 members and guests attended. The Prime Minister, who should have attended as principal guest, was unable to be present and his place was taken by the Rt. Hon. Reginald Maudling, P.C., M.P., President of the Board of Trade. Seated at the top table were His Excellency Jean Chauvel, G.C.V.O. (French Ambassador); His Excellency John Hay Whitney, C.B.E. (Ambassador for the USA); Dr. L. B. Pfeil, O.B.E., F.R.S., (past-president, Institute of Metals); Sir Gilbert Rennie, G.B.E., K.C.M.G., M.C. (High Commissioner for the Federation of Rhodesia and Nyasaland); Rt. Hon. Viscount Knollys, G.C.M.G., M.B.E., D.F.C. (chairman, Vickers, Limited); Minister of State, Camille Gutt (Belgium); Mr. C. J. M. Alport, T.D., M.P. (Minister of State for Commonwealth Relations); Mr. G. L. Bailey, C.B.E. (past-president, Institute of Metals); Sir Frank Lee, G.C.M.G., K.C.B. (Joint Permanent Secretary to the Treasury); Mr. D. P. C. Neave (hon. treasurer, Institute of Metals); Air Chief Marshal Sir Thomas Pike, K.C.B., C.B.E., D.F.C. (chief of the Air Staff); Sir George Abell, K.C.I.E., O.B.E. (director, Bank of England); Mr. P. Chambers, C.B., C.I.E. (chairman, Imperial Chemical Industries, Limited); Col. Sir Charles Hambro, K.B.E., M.C. (chairman, Union Corporation, Limited); Sir Edgar Sengier, K.B.E. (président, Comité Permanent, Union Minière du Haut Katanga, Belgium); Sir Cyril Hawker (executive director, Bank of England); Mr. R. D. Hamer (vice-president, Institute of Metals); Mr. F. C. Braby, M.C., D.L. (chairman, British Non-Ferrous Metals Research Association); Sir Ronald Prain, O.B.E. (president, Institute of Metals) (who occupied the Chair); Major C. J. P. Ball, D.S.O., M.C. (past-president, Institute of Metals); Rt. Hon. Sir Eric Harrison, P.C., K.C.V.O. (High Commissioner for Australia); His Excellency Rene van Meerbeke (Belgian Ambassador); Mr. G. Ignatieff (Deputy High Commissioner for Canada); Rt. Hon. Viscount Chandos, P.C., D.S.O., M.C. (chairman, Associated Electrical Industries, Limited); Rt. Hon. Lord Forster, K.B.E., Q.C. (chairman, National Arbitration Tribunal); Dr. E. L. Dupuy (past-president, *Société Française de Métallurgie*); Professor Hugh O'Neill (senior vice-president, Institute of Metals); General Sir Alan Cunningham, G.C.M.G. K.C.B., D.S.O., M.C.; Sir Harry Melville, K.C.B., F.R.S. (secretary to the Committee of the Privy Council for Scientific and Industrial Research); Sir Edward Wilshaw, K.C.M.G., D.L., J.P. (governor, Cable and Wireless (Holdings), Limited); Sir Alexander Fleck, K.B.E., F.R.S.; Sir Vincent Tewson, C.B.E., M.C. (secretary, Trades Union Congress); Mr. H. G. Herrington, C.B.E. (chairman, Aluminium Industry Council); Mr. Julian S. Crossley (chairman, Barclays Bank, D.C.O.); and Professor Hugh Ford (vice-president, Institute of Metals). Most of these gentlemen were accompanied by their ladies.

After the "Loyal Toast," the toast to "The Institute of Metals and the Non-ferrous Metal Industries" was proposed by the Rt. Hon. Reginald Maudling, and Sir Ronald Prain replied. Major C. J. P. Ball proposed the toast of "The Guests" to which His Excellency John Hay Whitney responded. During dinner, music was provided by the orchestra of the Grenadier Guards and following dinner there was dancing until 1 a.m.

Mr. LEONARD WILLIAM BICKFORD SMITH, director of Newton Chambers & Company, Limited, of Sheffield, from 1938 until 1958, has died at the age of 83.

Link-Belt's New Malleable-iron Foundry

Account of Operations at the Mechanized Foundry of Link-Belt Company, in America

Equipment used in Link-Belt's highly-mechanized new malleable-iron foundry at their Ewart plant, in Indianapolis, allows of considerable flexibility of operations. A wide variety of work can be handled, and frequent changes in class of work to suit production requirements are possible. The new works produces various malleable and pearlitic detachable chain-links, gears, sprockets, buckets, conveyor parts and, in general, any other malleable castings needed in Link-Belt's extensive range of materials-handling and power-transmission equipment. These castings are produced mainly in blackheart and special grades of malleable, the melting system being based on duplexing of cupola and pulverized-fuel-fired air-furnace.* In the various sections of the foundry, moulding and pouring are arranged either on a continuous basis, or intermittently. In the former case, moulds are made in flasks or shells and cast on conveyors; in the latter the moulds are produced in snap-flasks, and arranged in banks on roller conveyors for pouring.

Link-Belt Company, of America, have recently built a new mechanized malleable-iron foundry at Ewart, Indianapolis, for the production of chain-links, gears, sprockets, etc., and other malleable castings needed in their range of mechanical-handling and power-transmission equipment. Five moulding lines have been efficiently arranged, utilizing mechanical devices that can handle production of moulds for special jobs in limited quantity, and small and production jobs continuously. High-speed automatic shell-moulding machines for high production are also installed. The flow of products from raw material to finished castings in each of these areas has been carefully analyzed for straight-line operation, and the foundry is so designed that it will function efficiently at various levels of production. The melting facilities consist of two No. 8 cupolas and two 30-ton air furnaces. The cupola blast has humidity control, and is preheated. Air to the coal pulverizers and secondary air to the air furnaces is also preheated.

Moulding

A completely automatic sand system adds the proper amount of bond, water and coal-dust to each batch of sand. The five moulding lines consist of: *Unit one*—two 18-station roller-conveyor lines; *Unit two*—a wheeled pallet conveyor line with 19 moulding stations for heavier work (this line accommodates cope and drag and rollover machines along with the heavier squeezers); *Unit three*—Link-Belt Tru-Trac (continuous-car type) mould conveyor with 14 moulding stations that carries the moulds from the moulding area to the pouring area, and then through a cooling zone to automatic dump on to shakeout screen, and *Unit four*—a shell-moulding line equipped with two automatic Link-Belt shell-moulding machines, each producing 180 shell moulds per hour (the shell moulds are carried on a trolley conveyor to the pouring area, and through cooling to an automatic dumping station). Part of Units three and four is shown in Fig. 1.

In addition to these fives lines, there is space available for specialized moulding methods that are being considered for the future. Hot metal is delivered to all pouring areas by electrified cab-operated delivery ladles (see Fig. 2). Auxiliary equipment includes dust-collection, heating, ventilation and lighting units which have been especially selected to make the foundry an ideal place in which to work.

Storage and Charging Yard

A tour of the new facilities would start at the material-storage and charging yard adjacent to the melting end of the new foundry. This yard is completely covered by a new steel-frame building 80 ft. wide by 300 ft. long, and is served by a 10-ton overhead crane spanning the full width of the yard. Raw materials arrive in railway trucks on a siding that extends the length of the yard area. At one end of this covered area is a concrete bin for storage of coke, and at the opposite end another concrete bin for storage of steel scrap. In an elevated position in the centre of the charging yard are the coke and limestone hoppers, and a batch-type weighing-hopper (equipped with a dial scale) for making up the metal charges. A section of the Link-Belt Pre-Bilt belt conveyor returns sprue from the tumbling mills back into the charging area of the foundry.

Sprue, pig and steel scrap are deposited by an electric magnet into the batch weigh-hopper directly under the iron loading platform, until the correct charge is indicated on the dial scale overhead (see Fig. 3). Three Syntron feeders automatically deposit

* This practice contrasts sharply with that adopted for several malleable foundries built recently in the UK, for example:—"Shotton Bros., Developments," JOURNAL, July 17, 1958; "Castings, Limited, expand their Facilities for Malleable Production," JOURNAL, July 24, 1958; and "Mechanization with Flexibility," JOURNAL, February 25, 1960 (Ley's Malleable Castings Company, Limited).—Editor.

FIG. 1.—*Continuous-pouring facilities for high-production castings at Link-Belt's new malleable-iron foundry in Ewart, Indianapolis. At the left is a trolley conveyor for shell-moulded castings, at the right a Tru-Trac car-type mould-conveyor. The men pour moulds "on the move," standing on moving platforms which run at the same speed as the conveyors carrying the moulds. The tunnel over the Tru-Trac mould-conveyor exhausts hot gases and fumes from the poured moulds.*

correct charges of coke and limestone into another batch weigh-hopper. Immediately below these batch hoppers, an electrically-operated transfer-car, carrying a cone-bottom charging-bucket, automatically locates under the metal-charge hopper and coke-limestone hopper to receive the cupola charge. The transfer car then moves into the melting area, where a four-ton underslung crane lifts the bucket from the car and drops the charge into the cupola (see Fig. 4). A typical charge consists of 2,400 lb. of metals, 200 lb. of coke and 80 lb. of limestone.

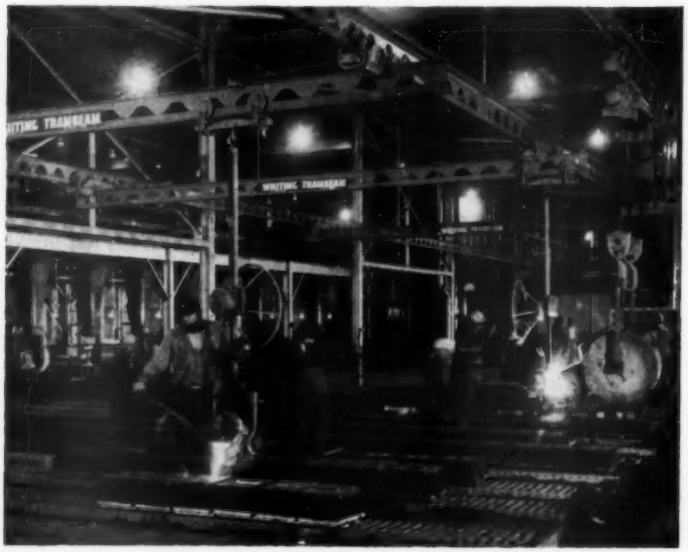


FIG. 2.—*In the roller-conveyor section, the telpher-type delivery ladle (right) transfers molten metal to a pouring ladle suspended by a bridge crane. Moulds are placed on roller conveyors at the far left and pushed into the pouring area. After castings have been poured they are allowed to cool, and then dumped into an oscillating conveyor under the grating.*

FIG. 3.—*Pig and scrap iron are deposited by electric magnet (left) into the batch weigh-hopper below the iron loading platform, and then dropped into a charging bucket when the correct charge weight is indicated on a dial scale. In the background, three Syntron feeders automatically deposit a correct charge of coke and limestone from storage hoppers into a weigh hopper.*

Melting

The duplexing melting process is employed, the scrap, pig and sprue being melted in either of the two 54-in. cupolas and run continuously into one of two air-furnaces, where the metal is refined and raised to tapping temperature (see Fig. 5). Molten iron from either of the cupolas flows through an X-shaped trough directly into either of the two air-furnaces, at temperatures of from 1,430 to 1,480 deg. C. These 30-ton furnaces, with hearth areas 34 ft. long by 8½ ft. wide, are fired with pulverized coal and raise the temperature of the iron to 1,620 deg. C. before it is tapped into delivery ladles. Each cupola is operated on alternate days, the air-furnaces being alternated on a weekly basis. The duplexing melting system is designed to provide continuous iron at a rate of 15 tons an hour. The control panel in the melting area includes controls for the weight, temperature and humidity of the cupola blast, for pulverizing coal to fire the air-furnaces, and for the operation of the waste-heat boiler, which utilizes hot gases from the air-furnace stack to generate steam for plant heating and processing. Molten metal is tapped into a 1,000-lb. cylindrical delivery-ladle suspended from a cab-operated overhead electric trolley and transported to the pouring areas, where it is transferred to pouring ladles suspended from bridge cranes.

First Unit

Moulds on the two roller-conveyor lines in Unit one are placed with bottom boards on one end of the roller conveyors and pushed into the pouring zone. There are 18 moulding stations in each line, and each station is served by two roller-conveyors. Each conveyor is 40 ft. long, half of which is used as the pouring section. After a sufficient cooling period, sand and castings together are dumped either directly on to an oscillating conveyor operating below floor level, or else on to a grating (see Fig. 6).

In the latter method, with many of the smaller castings so near the same shape and size that easy identification can be made only by number, it is more desirable to do the sorting right at the discharge end of the roller conveyor, before there is any chance of castings becoming mixed. When this method is used, the castings, sprue and sand are dumped on to a section of grating that permits only the sand to fall on to the oscillating conveyor, the sprue and castings being retained on the grating. Castings are then broken off the sprue and placed in containers to be trucked to the cleaning operation. Sprue is dropped through an opening in the grating on to the conveyor. In the former method,

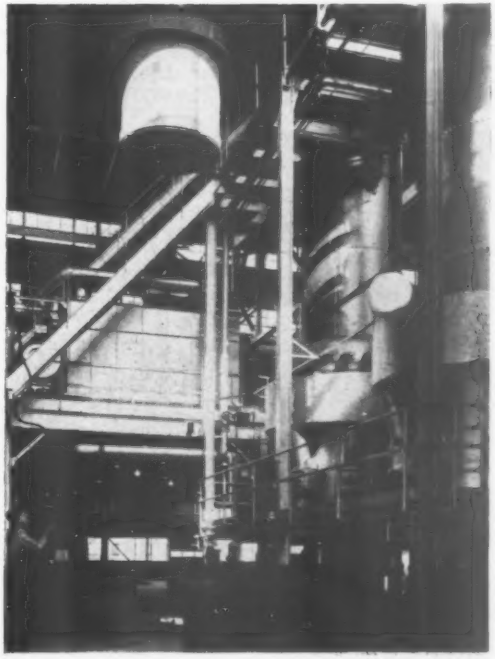


FIG. 4.—*The cone-bottom charging bucket is lifted, by means of a four-ton underslung charging crane, from a transfer car into one of the two cupolas that form part of the foundry's duplex melting system.*

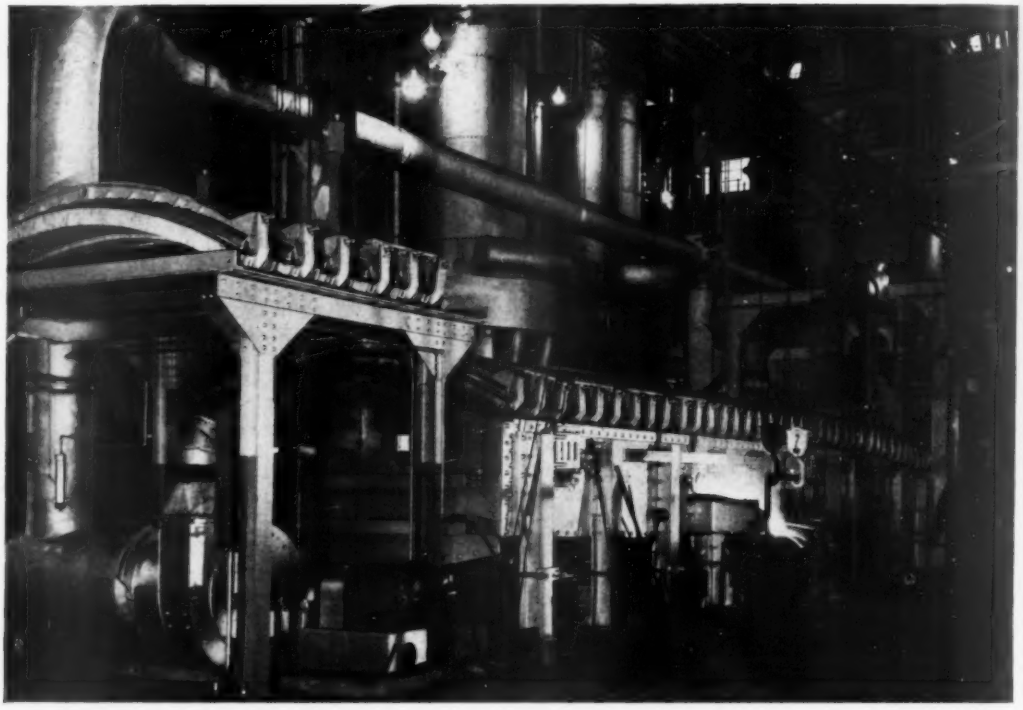
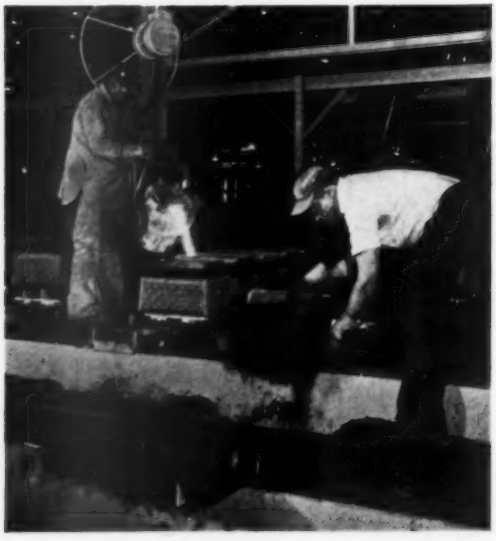


FIG. 5.—*Link-Belt's duplex system has two No.* 8 *cupolas, and two* 30*-ton air-furnaces* 34 *ft. long by* 8½ *ft. wide. The furnaces are fired with pulverized coal. Molten metal enters the air furnace from the cupola at about* 1,480 *deg. C. and is tapped from the furnace into the delivery ladle at* 1,620 *deg. C. Each cupola is operated on alternate days, the air-furnaces being alternated on a weekly basis.*



the grating is turned up and sand and castings are dumped directly on to the oscillating conveyor, which takes them to the shakeout screens. The sand is returned to the preparation plant, while castings and sprue take an additional cooling journey on the main-line Torqmount oscillating conveyor, which is 300 ft. long (see Fig. 7), and are then transferred to a sorting and spruing apron conveyor.

Sand from the shakeouts is discharged on to a belt conveyor which has a magnetic-head pulley for removing tramp iron. A bucket elevator elevates the sand for screening before it is returned to the storage bins at the sand preparation system. Sand that spills at the moulding stations drops into a spill-sand conveyor located under each line

FIG. 6.—*After cooling, moulds and castings are discharged on to an oscillating conveyor running under the floor, which in turn discharges to a vibrating shakeout screen that separates castings from sand. A grating is then turned up to allow mould sand, castings and sprue to fall on to a conveyor. Certain of the castings are separated on the grating.*

of moulding machines, and is returned with the shakeout sand to the sand preparation system.

Second Unit

Unit two consists of 19 moulding stations, nine of which are served by wheeled pallet conveyor lines carrying larger moulds made by cope-and-drag or roll-over moulding. These pallet lines are 40 ft. long, 20 ft. of which is the pouring section. As in the roller-conveyor lines, poured moulds may either be dumped down through an opening in the grating on to an oscillating conveyor, or dumped on to the grating for separation of sand, sprue, and castings at that point. Power-operated dumping devices are provided for the larger moulds.

Third Unit

The mechanized moulding line is designed for high-production work, and consists of a Tru-Trac car-type mould conveyor, with 100 cars on 4½-ft. centres, serving 14 moulding stations. Every facility is provided to save the moulder's time and help increase his productivity. Each man has his own overhead sand-hopper, with hopper gates air-operated by a knee valve, and his own core racks, which are constantly filled at his side. With moulding machine in front of him, sand directly overhead, core rack at hand, and endless car-type conveyor at his side the moulder works in ideal conditions, the moulds being carried away automatically as fast as he completes them. Each moulder has a mechanical counter at his station, to indicate the number of completed moulds that he has deposited on the conveyor. Completed moulds travel from this area to a zone where the weights on top of the poured moulds, and the jackets confining the moulds, are removed and transferred across the line to newly-made moulds.

Pouring and Shakeout

Three men pour simultaneously while standing on a moving platform, which consists of a double strand of chain with checkered floor-plate slats, and which travels at the same speed as the Tru-Trac conveyor. This ensures a fixed relationship between the pourer and the mould, with the men pouring "on the move." After pouring, the moulds pass through a short section of exhaust tunnel, where hot gases and fumes are exhausted through a stack. Weights and jackets are removed as the moulds approach a fan-ventilated cooling-room, where additional steam and gases are exhausted and cooling of the moulds is accelerated. The Tru-Trac conveyor loops within this area several times, and upon reaching the far end of the room automatically dumps moulds on to a shakeout screen, through the action of a roller on one side of the mould car that rides up and over a dumping cam located at the discharge point. Bottom boards are not discharged here, but continue on the conveyor back to the moulding area.

Fourth Unit

Two Link-Belt shell-moulding machines (see Fig. 8), two shell-closing machines, core-setters and a

FIG. 7.—*Torqmount oscillating conveyor, which serves all the moulding lines and shakeout screens. Over 300 ft. long, this oscillating trough receives castings from five shakeout screens and carries them to the No-leak steel apron conveyor, where they are sprued and sorted.*

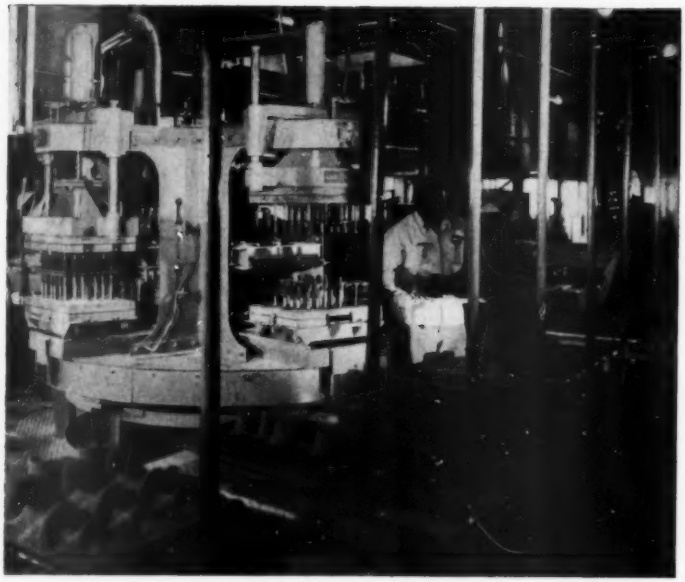
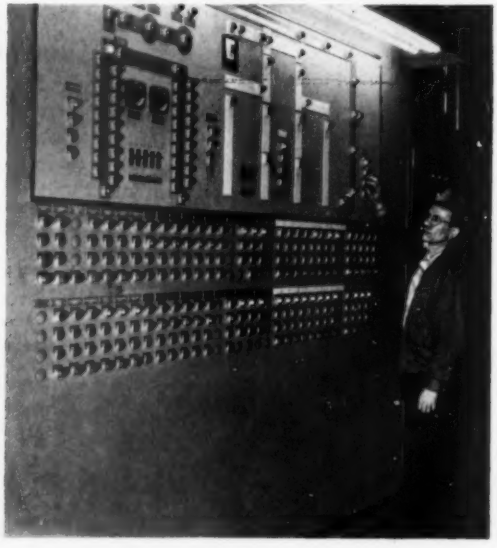


FIG. 8.—*One of the two Link-Belt four-station shell-moulding machines, each of which can produce* 180 *shell moulds an hour.*

complete shell-sand preparation system comprise the shell-moulding area. Moulds from the shell-closing machines are placed directly on an over-head - trolley mould - conveyor. The shell-moulding section is located parallel to the Tru-Trac conveyor line, and utilizes a similar moving platform and pouring loop. Sand for the shell-moulding system arrives by boxcars, and is unloaded by front-end loader and delivered to a receiving hopper in the floor, from whence it is elevated and screened during discharge to the sand-storage bin.

A mixer for coating sand with resin is located directly under the sand-storage bin. As sand is mixed with resin it is delivered to a surge bin ahead of the shell-moulding machines. The mix is fed to the shell-moulding machines by means of a screw feeder, so that from the time the sand is delivered to the feeding hopper until the time the shell is completed, the entire operation is mechanized. Completed moulds are placed directly onto the trolley conveyor and sent to the pouring area. After pouring, and sufficient cooling, the castings and sand are then automatically discharged to a shake-out screen. The castings and sprue are conveyed to the 300-ft. main oscillating conveyor and thence to the sorting and spruing apron, while the sand is carried away by Coilmount oscillating conveyor and bucket elevator for reclamation and storage.

FIG. 9.—*One of the two central panels controlling all phases of green-sand moulding, from automatic sand-preparation to return of sprue to the yard area. The amount of bond, coal dust, water, etc., added to the sand can be controlled from this panel. Dust collection, heating and ventilation systems and times of mulling, are also regulated here.*



Sand Preparation

In addition to the shell-sand preparation area, the new foundry also has two green-sand preparation systems for the other moulding lines. Two central panels (see Fig. 9) control all phases of green-sand moulding, from the completely automatic sand-preparation to the return of the sprue to the storage yard. The same panels also control the dust-collecting system, heating, ventilation and lights. Each of the two sand-preparation systems consists of a 200-ton storage-bin alternately feeding two 4,000-lb. mullers. A laboratory technician stationed at these mullers takes samples of prepared sand every 20 minutes, and makes any necessary changes to the proportioning of bond, coal dust, water, etc., and time of mulling cycle. After the sand is properly mulled, it is automatically discharged into a collecting hopper over a feeder belt below the floor, permitting the mullers to start preparation of a new batch. This feeder belt carries the prepared sand from the collecting hopper into a centrifugal-discharge bucket-elevator for delivery to the Link-Belt Revivifier overhead, where sand is aerated before delivery to the moulders.

A transfer belt conveys the sand from the Revivifier to an overhead distributing-belt which serves the moulder's hoppers. The distributing belts feed sand to all the lines except that for shell-moulding. The sand that is discharged to the distributing belts is ploughed off automatically, with a system of timing that keeps each moulder supplied with sand regardless of his hourly requirements, and reduces the amount of sand spilled over the end of the distributing belt to a minimum. The hoppers are of 30-cub. ft. capacity, and a full hopper above each moulding machine represents on the average 30 minutes supply of sand for the moulder. Each hopper is replenished as needed, and hoppers average two-thirds full at any time. This sand-handling system is as flexible as foundry engineers can make it, and there is virtually no chance that a moulder will run out of sand. New sand is brought in from the storage yard by truck as required and dumped through gratings at floor level, from whence it enters the return-sand conveying system.

Coreshop

The core room at the Ewart foundry is located adjacent to the new plant, and various operations are mechanized. Silica and lake sand are delivered by railway truck and transferred by gravity chute to storage in the basement of the core room. Sand is elevated by bucket elevator to the mulling area, where core sand is prepared according to any of eight different mixes needed. Unbaked cores are placed on a belt conveyor that takes them to a vertical tower-type baking oven. After baking, the cores are inspected and placed on trays for delivery to storage or to the moulding lines.

Annealing and Finishing

Since malleable iron when poured is in the form of white or "hard" iron, and is very brittle, it has to be annealed (heat-treated). For this purpose the completed castings are packed into annealing pots, supported with red flint gravel to prevent warpage, and delivered to annealing ovens, of which there are 13, each 18 by 25 ft. Pulverized coal is used to fire these ovens, and 30 to 32 hours are needed to bring them up to a temperature of 882 to 893 deg. C., which is maintained for 48 hours. After this period has elapsed, the burners are shut down and the temperature allowed to drop by five deg. an hour to 599 deg. C., at which temperature the front of the oven is unbricked and the contents allowed to cool.

FIG. 10.—*Typical castings made at the Link-Belt foundry: six cast chain-links, two elevator-buckets, a roller and a belt-conveyor idler-bracket.*

The annealing department is located adjacent to the new foundry building and the castings-cleaning, inspection, grinding and sorting departments. From the cleaning units, the annealed castings (that are now "malleable") are loaded into tote boxes and moved to a battery of high-speed grinders for finish grinding, from whence they are taken to inspection and any special finishing operations. Following the final inspection, the castings are finally transferred to the machining and assembly departments. Typical castings produced at Ewart are shown in Fig. 10.

George Kent sells Steering-gear Division

The steering-gear division of George Kent, Limited, makers of industrial instruments, etc., of Luton, is being sold to Cam Gears, Limited, also of Luton. George Kent has been making these products for Cam Gears for nearly 30 years. After the sale George Kent will hold 40 per cent. of the enlarged equity capital of Cam Gears.

The Ross Gear & Tool Company, one of the largest independent manufacturers of steering gears in America, will subscribe for cash 20 per cent. of the Cam Gears capital and the present holders of Cam Gears will hold the balance.

G. & J. Weir extends French Interests

A substantial minority interest in the issued share capital of La Société d'Installations Thermiques et Auxiliares de Machines (S.A. ITAM), of Paris, has been acquired by G. & J. Weir, Limited, engineers and founders, of Glasgow. The two companies have also entered into an agreement for the co-ordination and exchange of technical effort on products in which they are jointly interested.

The agreement also provides for joint sales representation in the Italian market and for the appointment of S.A. ITAM as exclusive agents for the sale of all Weir products in France and Belgium.

"Gas at Work" Exhibition

By a Local Correspondent

The "Gas at Work in Industry" Exhibition, held in the New Exhibition Hall, Harrogate, from March 28 to April 1, attracted a wide interest among foundrymen and engineers in the north of England. It was organized jointly by the North Eastern and Northern Gas Boards, and was the first of its type ever to be held in the provinces.

Prior to the opening ceremony, some 150 people comprising industrialists, local-authority representatives, Gas Board officials and members of the Press were entertained to an inaugural luncheon. After this, Sir William Scott, O.B.E., J.P., managing director of Armstrong Whitworth (Metal Industries), Limited and Jarrow Metal Industries, Limited, opened the Exhibition (see Fig. 1). In his address, he spoke of the prospects of the gas industry in relation to the Clean Air Act. Such exhibitions as he had had the pleasure of opening could be considered, he said, as "temporary universities of learning." In these days of fierce competition throughout the world, it was essential, Sir William added, that technical education and experience should be widely broadcast, and exhibitions were an excellent medium in which to carry this out.

Background

It was evident to the writer at the outset of the Exhibition that research into the uses and applications of gas for the North and North-Eastern areas of England had made excellent progress over the last few years, and, in co-operation with industry, many problems of controlling gas heat had been investigated and developed with enthusiasm. Applications of various types of heaters and burners catering for temperatures well over 1,000 deg. C. had been rigorously tested in practice, and demonstrations and trials could be arranged. Safety measures and explosion-proof devices had also been developed to a high degree of dependability, any accident of human error or unit failure being covered from every conceivable angle and indicated by suitable warning systems.

FIG. 1.—*Sir William Scott in humorous mood while opening the "Gas at Work in Industry" Exhibition, at Harrogate. Also on the platform is Dr. R. S. Edwards, chairman of the North Eastern Gas Board, which is housed in Leeds.*

Notes on Exhibits

To the JOURNAL representative, a notable feature of the exhibition was that in many cases companies had "live" exhibits. Owing to space limitation, it is not possible here to detail all the items and equipment on show of interest to foundrymen. However, to briefly describe gas heat as used in a moulding shop, there appeared to be three methods displayed: (1) plain gas as taken from the town's supply pipe to a variety of burners with holes, slots or rings, to generate certain types of flame; (2) high-pressure gas which is boosted after being taken from the service pipe prior to delivery to the correct type of burner, and (3) gas used with forced draught. At the Exhibition, fan-blown air taken from a common service supply-pipe in the building was controlled by pressure regulation to suit the type of burner used.

A good example of the gas-torch type of burner (that used for cupola lighting) was on show. This comprised a Y-type junction twin-pipe (one for gas and one for air), a mixer and a torch-type burner. In use, the flame is projected at the kindling coke arranged beehive fashion in the well of the cupola. When the coke bed is burning freely, the gas is turned off and the air pressure left on so as to blow the cupola coke-bed into incandescence to a height well above the tuyeres. Foundrymen appreciate the advantages of a well-burned-up coke-bed before charging begins. By the use of gas in this way, the uncertain and erratic metal melting timetable which often results when damp firewood and shavings are used can be avoided completely—as also can the time spent in splitting the ex-railway-sleepers, etc., which are often used as cupola kindling material! The same remarks can be applied to the drying of shanks and ladles. Using dependable methods and equipment for ladle and launder drying, it is possible to obtain hot metal at the first tap into a bone-dry ladle. "Pigging" of the first metal down is thus unnecessary, and the resulting economies are considerable.

Drying, and Shell-moulding

Another interesting item displayed was a gas-fired portable hot-air dryer (fitted with spark-ignition and flame-failure equipment) which is a type of plant used extensively for moulds made in pits. "Burnt" patches which can occur when hand-stoked heaters are not properly looked after are a thing of the past with this type of equipment. Continuous stoves—vertical and horizontal—have certainly revolutionized core-drying and handling over the last two decades, and costs have been cut to a minimum. A well-established model of a gas-heated shell-moulding machine was also on view. This machine was shown working from a 24 by 16 in. patternplate with a 3-in. lift. Included in its set-up was a temperature indicator, thermostatic control and a push-button arrangement which turned the patternplate over on the dumpbox. An electronic timing device controlled the thickness of the shell.

To keep pace with all the developments of uses for gas, accurate industrial meters and process-control systems are essential, and at the Exhibition were shown clocks, dials, starters and stoppers for almost every possible application. The instruments shown were of robust construction and obviously reliable.

Organizers and exhibitors generally are to be congratulated on staging a most informative and complete "Gas at Work in Industry" Exhibition. So great was the local interest that the closing time on the final day was extended to 8.30 p.m.

Vitreous-enamelled Cast-iron*

By J. R. Park

With the passing of each year, better and brighter vitreous-enamelled finishes are expected by the public. Competition from other materials, such as plastics, with their bright colours, durability and finish must be taken into consideration if vitreous-enamelled cast-iron components are to hold their place. Another serious competitor is the enamelled sheet-steel pressing, which is in fact now used as a form of streamlining surrounding cast-iron articles, one might almost say to hide them. In others days the cast-iron article itself would have been vitreous enamelled—many still remain as monuments to the material's durability.

As in other walks of life, fashions in vitreous enamels change, and sometimes these changes can considerably increase the difficulties of both the foundryman and the vitreous enameller. An example of this was the going out of fashion of heavy colour-contrast mottled finishes. Their place was taken by light low-colour-contrast mottles, plain pastel shades and plain white and off-white finishes. As enamelling defects on plain colours are more readily visible than they are on the heavy-contrast mottled colour, the rate of rejection increased considerably, a state of affairs which called for action on the part both of the foundryman and the enameller.

To what extent are the faults in enamelled surfaces due to the casting, the surface preparation, the enamelling process and finally to the enamel itself? As in all cases where a process passes through several hands, there is a tendency to put the blame on the "other man." Whilst it is not the writer's intention to deal with faults which are usually attributed to the enameller or the enamelling shop, it will perhaps be useful to outline what some of these are.

Faults in the Enamelling Shop

Enamel Application

Too-thin spraying of enamel causes wrong colour or black specking, whereas thick spraying increases tendency to chip. Incorrect operation of the spray gun can cause rippling, and thick ground-coats can cause blistering of the finishing coat.

Firing and Handling

Over-firing can result in devitrification, and consequently loss of brilliance—under-firing can also cause loss of brilliance. Impurities in the furnace atmosphere may cause a variety of faults; and of course dirt, from whatever source it originates, is a prolific source of trouble. Faults due to inefficient handling can occur at various stages, and are mostly avoidable.

Chipping and Crazing

Whilst chipping and crazing faults *can* show themselves quickly, they often do not show up until some time afterwards. This applies particularly to crazing, and when this occurs after the article has been in use it is difficult to determine whether it is the fault of the casting, the enamel or the user. The chief cause of chipping and crazing appears to be incorrect adjustment of the co-efficient of expansion between the enamel and the casting. If the enamel is in tension crazing is likely to occur, whilst if in excessive compression chipping is likely to happen. Several factors in the enamelling shop are of importance. The most important of these is cleanliness, followed by speed of processing and efficient supervision.

Foundry Defects

As previously stated, there is always the temptation to blame the other man for faults when a process passes through several hands, and vitreous enamelling is no exception. The enameller blames the enamel, the cleaning process, the annealing or the casting. The foundryman puts the blame on all the subsequent operations. The fact, of course, must be faced, that some of the faults are due to the foundryman. Many casting defects which cause enamelled products to be rejected can be detected by the usual rapid visual examination of the casting in the foundry, and many more are detected after the cleaning of the casting prior to enamelling. Whether a more thorough inspection of castings at each stage would result in a reduction in the number of enamelled rejects is one of those questions which it is difficult to answer. It suffices to say that, from the foundryman's point of view, it is to his advantage to see that every effort is made to prevent defective castings reaching the enameller.

Metal Composition

In Britain, castings for vitreous enamelling are usually made from phosphoric irons, the phosphorous content varying from 1.0 to 1.5 per cent. Whether there is any one composition which is the ideal for enamelling, is doubtful. It does, however, appear to be good practice to keep the composition of any one type of casting within fairly narrow limits. The variations in metal structure due to fluctuations within the usual range of the common elements found in cast iron do not appear to cause any trouble, provided the iron is not allowed to become hyper-eutectic. In general, provided the casting is grey and sound, it should be satisfactory for vitreous enamelling.

Methods of Running

It is the generally-held opinion of most foundrymen that the important surface of the casting should

*Originally published in the Autumn/Winter, 1959, edition of *Bradley's Magazine*—reproduced by permission.

Vitreous-enamelled Cast-iron

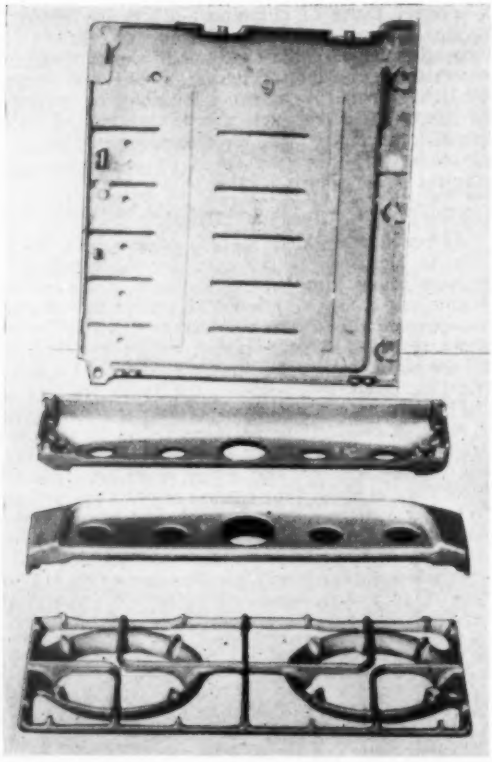
be in the bottom of the mould. This is based on the well-tried theory that dirt, slag, etc., collects at the top. However, a wise foundryman will not rely solely on this, but will see that as much dirt, slag, etc. as possible is prevented from entering the mould cavity, by the use of strainer cores, slag traps, etc. Careful attention to ladle cleanliness and good skimming-practice will also help. Each foundry usually has its own pet method of running any particular type of casting and each of these are usually successful.

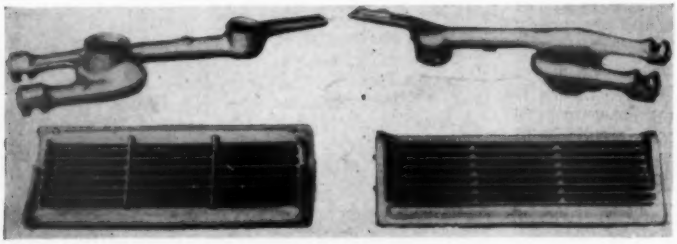
Pouring Temperature

Within a reasonable range, the pouring temperature of the metal does not appear to affect the ability of a casting to enamel in a satisfactory manner. Extremes of temperature should be avoided, so as to avoid sand burning-on if the metal is too hot, and cold-shuts and subcutaneous and other blowholes if the metal is too cold.

Moulding Methods

It is, of course, essential that every care be taken at all stages during the ramming of the mould. Facing sands should be chosen to give a good surface-finish, and care should be taken to see that there is no loose sand in the mould cavity and the running system. Both hand- and machine-moulding appear to be equally satisfactory, although some people contend that certain types of moulding-machine methods are liable to leave small quantities of loose sand in the mould.





Group of typical castings which are vitreous-enamelled for assembly into gas cookers; from top to bottom: side castings, facia panels, top frets, burners and grids.

Defects in Castings

" Rat-tails "

There is no possible valid reason at all why any casting which has faults which could have been detected by normal but strict inspection methods should be vitreous enamelled, so that the only defects which are really important are those which only become evident after enamelling. One of these faults has been given the name of " rat-tails." These occur as elongated depressions on the flat surface of thin castings, and are almost always associated with the streams of metal entering the mould from the ingates. The theory is, and there appears to be a good deal of evidence to support it, that the stream of molten metal causes the sand in contact with it to expand, and this expansion is taken up by a buckling of the still-plastic sand at the edges of the stream. When the mould is full, these buckles remain and cause small depressions on the face of the casting. Considerable research has been undertaken to find a cure for this troublesome defect, and it is known that certain conditions of the moulding sand can decrease or increase the tendency for this fault to occur.

The trouble is decreased by using a sand of which the screen analyses cover a wide range, whilst it can be increased by using a sand having a limited screen analysis. It is claimed that the addition of what some people call " expansion joint materials," such as wood floor, is, at least, partly an answer to the problem. Hard ramming is said to aggravate the trouble, and the use of a tough sand which removes the necessity for hard ramming is said to help in its prevention. There appears to be some advantage in tilting the mould and running from the bottom, but, as previously stated, it remains a troublesome defect.

Sand and Slag Inclusions

Castings with obvious holes will have been eliminated in the foundry inspection. Such defects as sand and slag inclusions, however, often only become obvious after shot-blasting has removed these inclusions, leaving a hole in the surface of the casting. The prevention of these has already been outlined, and consists of: taking all possible steps to see that no loose sand is left in the mould cavity; the use of slag traps in the running system, and, perhaps most important of all, efficient ladle-skimming. One of the best preventatives against slag entering the mould is the use of ladles with tea-pot spouts. Holes can be filled, but it is always a somewhat doubtful remedy.

Design

How far the design of a casting is responsible for defects after enamelling is not an easy question to answer. However, it is a generally-accepted fact that design does play an important part in the production of good-quality enamelled products. A number of the principles which go towards the making of a good casting, from the foundryman's point of view, are also desirable from the point of view of the enameller. The designer should aim at castings of a uniform section, avoiding as far as possible sharp corners, abrupt changes of section and projections such as lugs, bosses and ribs. Changes of section and projections are factors which influence cracking and warping, two problems which plague both the foundryman and vitreous enameller. As in other branches of industry, close co-operation between the designer, foundryman and enameller is essential.

Blistering

Blistering is one problem of which the cause is often not apparent. Is it the fault of the foundryman, the metal, the enamels, or the enameller? The question is a difficult one, as when a blistered enamelled part is stripped there is often no visible blemish on the surface. Blisters are caused by the evolution of gas from the iron/enamel interface, and this evolution of gas is also blamed for other defects such as pinholes and black specks. Not all casting surfaces are perfect, and even though shotblasting may open out some of the subcutaneous blowholes which may be present, it is possible that some still remain under the surface. When the enamel is "fired," there is a danger that any gas which may be present in the blowholes will be driven out. If the enamel skin is too strong to be broken a blister will occur, whilst if the skin is weak and very plastic a hole will be the probable result. However, not all blistering is caused by sub-surface blowholes, and in fact in many cases it is difficult to pin-point the actual cause. Some years ago, examination under the microscope of both defective and sound vitreous-enamelled surfaces indicated that almost all enamels contain gas holes, and it is merely the size and distribution of these holes which determine whether a component is considered as blistered or sound. This fact must strike a chord in the minds of many a foundryman.

Formation of CO Gas

One theory put forward to explain blistering is that during heating, and before the enamel commences to fuse, a certain amount of iron oxide is formed on the casting. When fusion has taken place, and the enamel has completely covered the surface of the casting, this oxidation ceases. As long as the temperature is kept below about 700 deg. C. no harm is done, but above this temperature the graphite in the casting begins to react with the oxide, with the formation of carbon-monoxide gas. This gas can only escape by bubbling through the fluid enamel. As long as the fluidity of the enamel is high the holes made by the escaping gases will heal themselves. As the fluidity of the enamel falls, with falling temperature, the ability of the gas holes to heal themselves gets less, and the surface of the enamel is then spoiled by pinholes and blisters. A secondary effect of the bubbling caused by escaping gas is that discoloured enamel may be brought to the surface, resulting in what is known as specking.

It has been suggested that the enamels themselves may be a source of gas, due to the presence of easily-reduced oxides, and that there is a possibility that these may react with the graphite at the face of the castings, with the formation of gaseous carbon monoxide.

Cleaning

For the production of first-class enamelled surfaces, cleanliness is of the utmost importance, and many of the troubles encountered can be attributed to inadequate cleaning. The cleaning process is usually carried out either by acid pickling or by shotblasting, using metallic abrasives as the cleaning media. Whichever method is used, it should be the aim of the operator to produce a surface which is clean and, at the same time, slightly etched to form a "key" for the enamel.

Conclusion

It is an undoubted fact that raw enamels and their application and firing methods have improved considerably in recent years. Whether the improvement in the quality of castings for vitreous enamelling has kept in step is a difficult question to answer. New moulding methods, however, have done much in recent years to improve the surface of castings. There does not appear to be any valid reason why vitreous-enamelled cast-iron parts should not continue to hold their own with the new materials. A vitreous-enamelled surface in modern pastel shades is a thing of beauty and a joy to behold.

IT WAS ANNOUNCED at the annual reunion of the Federation of British Industries Overseas Scholarships Scheme that to date 357 students from 37 underdeveloped countries had participated in this praiseworthy effort.

QUE QUE, the new Southern Rhodesian steel town, is building for the African population a new housing estate consisting of 334 houses. A school with 24 classrooms is also being built.

Midlands comment on Scrap

At the annual luncheon in Birmingham, on March 31, of the Midland Scrap Iron, Steel and Metals Association, Capt. H. Leighton Davies, assistant managing director of the Steel Company of Wales, Limited, and chairman of the Scrap Committee of the British Iron and Steel Federation, who was the principal speaker, advised scrap iron and steel managers to guard against the possible temptation to raise scrap prices. "Don't try to be spectacular and don't try to be smart alecs," he warned, and added "We realize in the steel trade that scrap represents an industry in itself and must make profits but don't create fictitiously high prices."

Mr. J. D. Norton, president of the Association, referred to a description of scrap given recently in a speech by the president of the Midland Ironfounders' Association, and said that the suggestion that the scrap industry was hoarding scrap to keep up the level of prices was so unrelated to fact that it was almost not worthy of reply. Early last year, when the foundry trade, in common with many others, experienced a sharp recession, and Government control on prices and qualities of scrap was removed, buyers of cast-iron scrap reduced the prices they were willing to pay to levels which were often totally uneconomical to traders. There should in consequence be no complaint, he said, if prices tended to rise when demand for good-quality scrap exceeded supply. "I am confident that the trading activities, business integrity and general conduct of the great bulk of our members would withstand any scrutiny, and that our consumer friends —almost without exception, are aware of this," Mr. Norton said.

Other speakers at the luncheon included Mr. J. N. Connell, president of the National Federation of Scrap Iron, Steel and Metal Merchants; Mr. A. B. Stobart, director of John Summers and Sons, Limited; Mr. R. C. Hilton, divisional traffic manager of the British Railways Western Region, and Mr. F. Allen Rowland.

United Steel's Sixth "Responsibility" Conference

For the sixth successive year, 110 apprentices and junior operatives from all branches of the United Steel Companies, Limited, have volunteered to take part in a weekend residential conference on the theme of "responsibility" to be held at Downing College, Cambridge, from April 8 to 11. It will consist of talks by leading industrial and educational authorities interspersed by discussion groups.

Chairman of this year's conference is Mr. Kenneth Davis, a director of Radiation, Limited—who also took the chair in 1956 and 1959—and the principal speakers will be Mr. L. B. Birch, deputy director of Sheffield University's Institute of Education, Mr. H. P. Forder, a director of United Steel and general manager of Samuel Fox & Company, Limited, and Mr. A. G. Dickson, secretary of the Commonwealth Studies Committee of the Royal Commonwealth Society.

Questions on the responsible use of leisure will be prepared for submission to an open forum panel, whose members will be Mr. Davis, Mr. J. O. Blair-Cunynghame, a director of the Royal Bank of Scotland and until recently staff member of the National Coal Board, the Ven. M. T. Dunlop, Archdeacon of Aston, Birmingham, and Mr. T. S. Kilpatrick, a director and general manager of Workington Iron & Steel Company.

British Exhibits at AFS Show

Foundry Services International, Limited

In addition to the details published last week of stands of British firms at the exhibition to be staged in Philadelphia by the American Foundrymen's Society (from May 9 to 13), information has now been received of Foundry Services' participation. Visitors to this stand (Foundry Services, Inc., of Cleveland) will see an actual metal-pouring demonstration of the application of two casting aids—Feedex exothermic materials and Logas "50"—in pouring and degassing operations. Representative castings showing quality obtainable with these and others of the groups' products will also be on display. (Logas 50 is a briquette developed for removing dissolved hydrogen from molten copper and its alloys).

Fordath Engineering Company, Limited

Fordath Engineering Company, Limited, will be exhibiting shell-sand coating equipment at the Philadelphia Show. One item selected for exhibition is a complete "350" model coating unit and this will be shown under operating conditions. Also on view will be a new small-capacity unit (model "150") with an output rating of about two tons of coated sand per eight-hour day. Sales of Fordath coating equipment in the USA are handled exclusively by the Shalco division of the National Acme Corporation of Cleveland and the UK firm's exhibits will form a part of the Shalco stand. Mr. J. Masters and Mr. C. Harris from Fordath will be in the States for three weeks, including the exhibition week. It is reported that Fordath coating units have now been installed in no fewer than eleven countries (20 of them in the US).

International Reception

According to Mr. Wm. W. Maloney, general manager of the American Foundrymen's Society which is sponsoring the national Castings Congress and Exposition, equipment buyers and sellers from over 20 foreign countries are scheduled to attend. So great has been the foreign interest that an international reception has been planned for Monday evening, May 9, at the Sheraton Hotel, Philadelphia, where an official welcome is to be given to the many foreign foundrymen. Already registered are foundrymen from Australia, India, Japan, England, Finland, Germany, Belgium, Sweden, Switzerland, Italy, Holland, Russia, Mexico, and several Central and South American countries.

Metal Industries acquires Belfast Scrap-metal Firm

The Belfast firm of scrap iron, steel, and metal merchants, John Lee, is to be acquired by Metal Industries, Limited. The business is being transferred immediately to Cox & Danks, Limited, a wholly-owned MI subsidiary, but will be conducted under the name of John Lee.

The price paid is £45,750, of which £9,100 is to be satisfied by the allotment to the vendors of 2,600 fully paid ordinary MI shares and the balance in cash.

EIGHT OF THE LARGEST ENGINEERING COMPANIES in Derby, employing over 15,000 people, introduced a staggered hours working week on Monday, March 28, in an effort to help ease traffic congestion in the town. The scheme means that factories finish work at various times between 4.30 p.m. and 5.30 p.m. instead of all closing at the same time. The scheme was evolved after a meeting of industrialists called by the Mayor, Councillor George Collier, in which he appealed to them to help avoid congestion at peak hours and reduce risk of road accidents.

SECTION DEVOTED TO THE TECHNOLOGY OF PRODUCING DIMENSIONALLY-ACCURATE CASTINGS

Investment-casting Experience

Preformed Refractory Cores, and Casting Behaviour of Ni/Cr Alloy

By N. Walker

The Author gained his early industrial experience with the Brown-Firth research laboratories and the Blackheath Foundry of Firth-Vickers Stainless Steels, Limited, before joining Hadfields, Limited, in 1946. He has been occupied with the development of investment casting and shell moulding, and is at the present time manager of these departments at Hadfields Foundry and Engineering Company, Limited.

So much has been written on the subject of investment casting that, in order that this paper shall not be a repetition of material previously published, the Author describes only two aspects of his experience in his foundry. The two subjects concerned are the making and using of pre-formed refractory cores, and the effect of nitrogen content on the casting behaviour of a nickel/chromium alloy in which his firm is interested. Both these matters required quite an appreciable amount of experimental work before they were finally satisfactorily resolved. Regarding the pre-formed cores, it was eventually decided that the extra cost entailed was less than the cost of those scrapped castings which resulted when using a normal investment technique.

PRE-FORMED REFRACTORY CORES

The development of the aircraft gas-turbine has involved the use of alloys suitable for the high temperatures concerned, but, in spite of the excellent qualities of these alloys, thermal-shock cracking troubles have been experienced which have necessitated changes in the design of the components themselves. The use of hollow-nozzle guide-vanes has become fairly widespread, and the production of these components as investment castings has provided new problems for the foundryman to resolve. The main difficulty to be overcome is the provision of a strong refractory core to form the long aerofoil-hole down the centre of the casting.

Initially, the Author's foundry produced these castings by a normal dipcoating and investing technique, but it was soon obvious that these castings presented problems requiring the greatest possible care in dipcoating and a high degree of packing during investing. Any failure to cover completely the inside of the hole during dipcoating, or the inclusion of any air bubbles in the coating itself, could give rise to surplus metal in the hole after casting, which might necessitate the casting being scrapped. Experience showed that, of the "waster" castings found, a very considerable proportion was scrapped for reasons associated with that portion of the mould forming the hollow casting. There can be no doubt that many of these troubles can be avoided in a normal dipcoating and investing technique, but it was felt that greater assurance of success could be anticipated if the aerofoil hollow down the casting could be made by means of a pre-formed core, which could be examined carefully before production commenced.

Investigation of Core-production Methods

A number of methods of producing cores were investigated. Typical of these were the extrusion of a suitable plastic refractory mix, the casting of a refractory slip, and the ramming of a refractory mix into suitable moulds. Such methods were eventually abandoned, as the product was inconsistent or the methods did not lend themselves to high production rates. From the company's experience of producing cores in connection with the shell-moulding process, it was felt that a promising approach would be that of blowing a suitable refractory material into a corebox of the aerofoil shape concerned. The use of sodium silicate as a binding material was decided upon, and, by using carbon dioxide as a setting medium, the cores were hardened in the corebox, thus minimizing the risk of distortion on stripping from the box. Mixtures of silica sand and silica flour were examined and satisfactory cores, with a good standard of surface-finish, were achieved. The use of silica had to be discontinued, however, as firing the moulds gave rise to distortion of the cores, due, no doubt, to the differential expansion of silica and the moulding material itself.

Zircon Sand and Flour

Zircon sand and zircon flour were found to be more suitable in this respect, and cores were produced in mixtures of various proportions to find the best compromise in terms of surface-finish and

• Paper presented at the Paris Conference of the European Investment Casters Association, Mr. H. J. Meerkamp van Emden presiding.

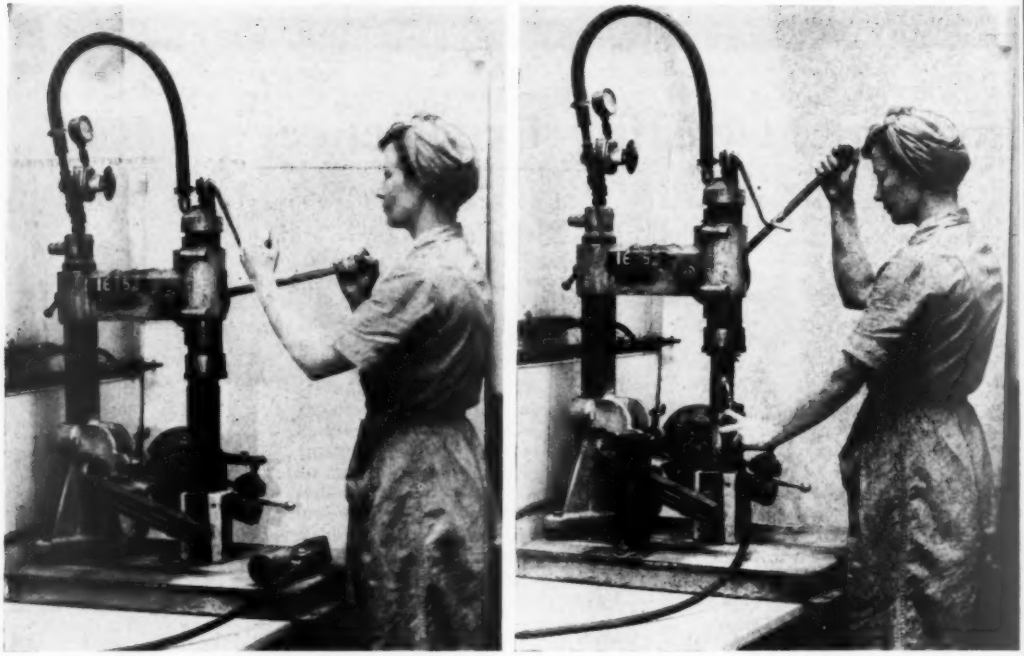


FIG. 1.—*(left) Blowing of the core, using a cartridge-type coreblower, the corebox being produced from phenol-formaldehyde resin, and (right) the equipment used for gassing the blown core, whilst it is still positioned in the corebox, with carbon dioxide gas.*

ability to blow the cores satisfactorily. It was found, for example, that it was impossible to blow mixtures containing above 30-per cent. zircon flour. On the other hand, mixtures containing less than 25-per cent. zircon flour were invariably poor in surface-finish, and gave rise to rough surfaces on the castings. The best all-round results were achieved with a mixture of 70 parts by weight of zircon sand, and 30 parts of zircon flour bonded with 4 parts of sodium-silicate. The optimum mixture will, however, vary according to the nature of the core to be blown, and experiment is necessary to achieve the best surface-finish combined with satisfactory blowing characteristics.

FIG. 2.—*Removal of the core from the corebox.*

Gassing, Stripping, etc.

The cores are blown on a cartridge-type coreblower (see Fig. 1 (left)), and a suitable apparatus has been made for gassing the blown cores with carbon dioxide (see Fig. 1 (right)). After treating the blown refractory material with carbon dioxide the cores can with care be stripped from the corebox, as in Fig. 2. The use of a stripping medium was found necessary, and kerosene appears to be suitable for this purpose. At this stage the cores are extremely weak and liable to damage in handling. A considerable increase in strength is achieved by immersion of the core in hydrolized ethyl-silicate solution containing about 46 per cent. by volume of ethyl-silicate solution. The cores are then heated in an oven at 300 deg. C. until all fumes cease to be given off. For very thin cores, repeated immersions in ethyl-silicate solution and subsequent drying proves desirable. Further treatment of the cores by immersion in a solution of methyl-metha-

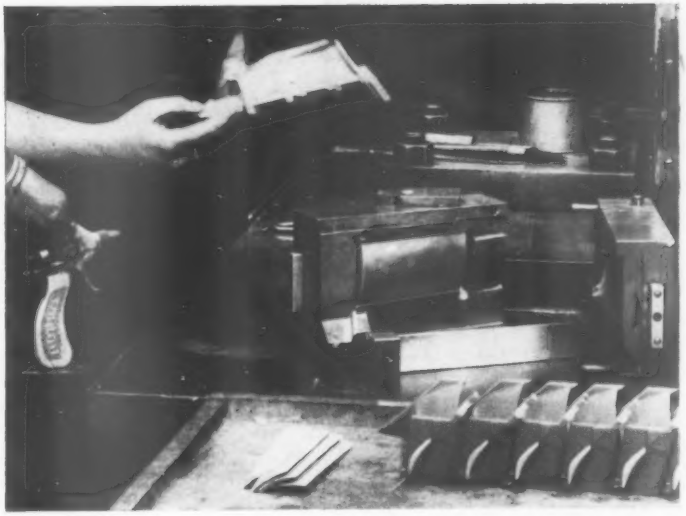


FIG. 3.—*Insertion of the pre-formed core into the wax pattern, after removal of the pattern from the wax-injection die.*

crylate (15 per cent. by weight) in chloroform, and drying, is useful in avoiding moisture pick-up during investing. This latter treatment confers additional strength on the cores and helps them to resist damage in handling—its effect is destroyed during firing of the mould, leaving the ethyl-silicate to provide the necessary high-temperature bond at casting temperature.

Corebox Material

Various types of material were investigated for coreboxes, and it was found that metal coreboxes (even hardened steel) gave a very poor life. Fortunately, the author's firm has built up considerable experience in the use of plastic materials for foundry patterns and coreboxes, and have found such materials to be very effective. Coreboxes machined from cast blocks of phenol-formaldehyde resin give long life, and a casting technique has been developed for aerofoil-type cores. This technique consists of mounting the steel core-piece from the wax-injection die in a plaster-of-Paris or soft-metal oddside, and casting the resin on to this, using a lacquer to prevent attack of the metal core by the resin.

The use of fillers, such as zircon flour, incorporated in the resin mix has been tried, and coreboxes of longer life achieved. The major disadvantage of such fillers would appear to be that any correction of the boxes to compensate for wear becomes impossible, as the material cannot be satisfactorily machined or hand-worked. Unlike the blowing of normal foundry sand cores, venting of the coreboxes is unnecessary. In fact, it is essential to avoid leakage at the joint faces of the coreboxes, otherwise fine material is blown out, leaving a loosely-packed core. This is particularly undesirable in the case of aerofoil-type cores, where poor packing at the thin edges would make them unsuitable for use. Constant attention to the fitting of the joint faces of the coreboxes is necessary, and insistence that the operators clean these faces before closing the box is also important. From a production point of view, this technique has proved capable of satisfactory development. A very high standard of inspection is imposed on the cores, both dimensionally and visually, but it is possible to produce upwards of 250 good cores per female operative in a working day.

Injection of Wax around the Core

The adoption of cores in wax-pattern production gave rise to further problems. The most obvious way of utilizing cores is to provide coreprints in the wax-injection die, and to inject wax around an inserted pre-formed core. It was found that the cores are quite strong enough to resist breakage, even when injecting wax in a viscous condition at high pressures. In the case of long aerofoil cores, however, it was found that breakage occurred, due to the fact that the cores cannot be produced to a high enough standard of accuracy to avoid stressing

FIG. 4.—*Wax patterns containing cores, and similar patterns assembled into a wax assembly prior to dipcoating.*

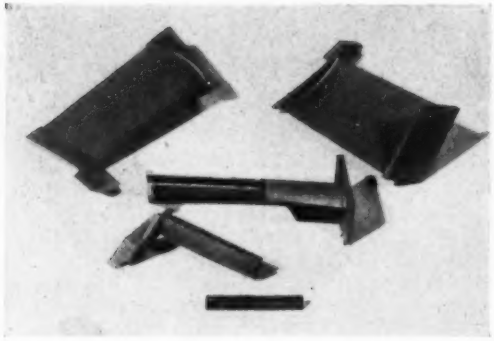


FIG. 5.—*Finished, and part-sectioned castings, showing the cored hole.*

during the closing and clamping of the dies. Expedients, such as the spring loading of the core-print areas of the die, or the use of rubber inserts to relieve these stresses, are not completely effective. These expedients can also give rise to misplacement of the core in the pattern. The proportion of cores broken by this means is quite small, but no method could be devised to check this breakage, except by destroying the pattern. One method of checking breakage consisted of painting a streak of colloidal-graphite along the length of cores, and checking the electrical conductivity after injection of the wax pattern. This technique did not prove reliable, however, and the injection of wax around the core for aerofoil applications was abandoned, although this method is quite feasible for cores of more robust proportions.

Core Insertion after Stripping

The alternative to this method proved to be the insertion of the refractory core after the stripping of the hollow wax pattern from the wax-injection die (see Fig. 3). The advantage of being able to inspect the portion of mould forming the cored hole before use will be obvious, and the production of large quantities of difficult castings has been facilitated by this technique. Fig. 4 shows a pattern assembly prior to dipcoating, and also wax patterns containing cores—finished, and part-sectioned castings can be seen in Fig. 5. The number of castings scrapped for core troubles is very small, and in the Author's estimation the cost of preparing the refractory cores is far less than the cost of the scrapped castings which would be expected from the use of a normal investment technique.

EFFECT OF NITROGEN CONTENT ON THE CASTING BEHAVIOUR OF A NICKEL/CHROMIUM ALLOY

The author has been aware for a long time that the remelting of steel in the indirect-arc furnace can give rise to an increase in gas content in the resultant castings. This is particularly true in the case of nitrogen contents, where serious pick-up can occur in a large variety of steels. In many cases this can be tolerated, but it is known that in 25-per cent. chromium, 12-per cent. nickel type material for instance, this increased nitrogen content can produce an alloy with a lower standard of ductility than the same alloy low in nitrogen. Again, in very low-carbon steels, of the order of 0.15 per cent. max. carbon, the pick-up of nitrogen can be extremely serious and result in castings containing blowholes, rendering them unsuitable for

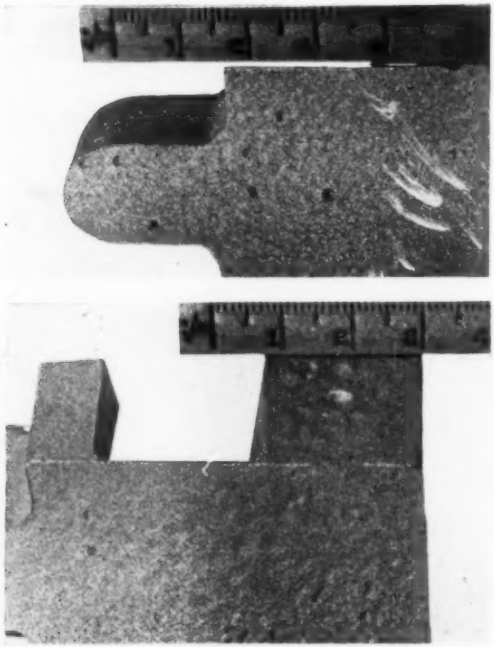
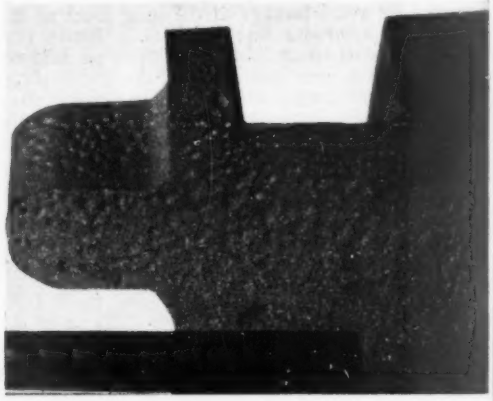


FIG. 6.—*Surface-rippling defects in investment castings, experienced at the author's firm when remelting 35-per cent. nickel, 12-per cent. chromium alloy.*



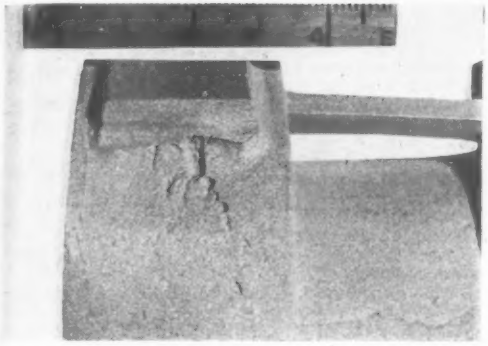


FIG. 7.—*Surface-cavity defects, resembling surface shrinkage, in high-nickel investment castings.*

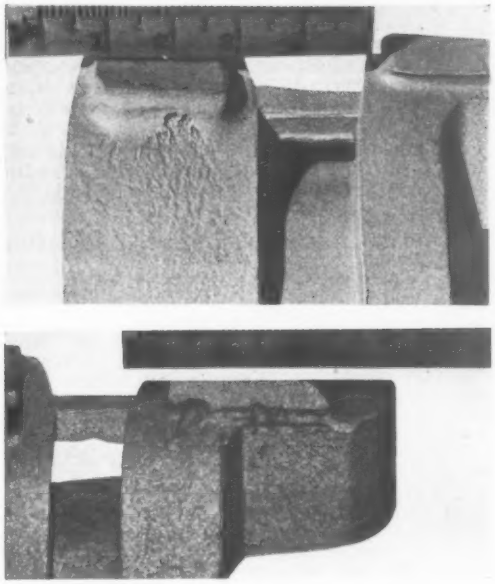
use. Some improvement in this situation can result from using melting stock small in size, and paying careful attention to (*a*) avoiding over-heating during melting down, and (*b*) maintaining the steel at high temperatures for too long a period. Additions made to the metal may also confer some benefits.

Unusual Defects

In the case of a 35-per cent. nickel, 12-per cent. chromium alloy, this pick-up of nitrogen gave rise to an interesting investigation. The Author's experience of remelting this material showed that, from time to time, scrap castings were produced showing defects unlike the general run of casting defects such as slag, dirt and dip-coat breakage. These defects evidenced themselves in two distinct forms, either consisting of surface rippling (see Fig. 6), which has also been seen on other alloys containing high percentages of nickel, or in the form of surface cavities resembling surface shrinkage (see Fig. 7). In spite of these obvious defects, X-ray examination of the castings revealed no internal faults of any kind. It appeared, therefore, that the method of feeding the castings was quite adequate.

Investigation

The author's approach to the avoidance of these features consisted of tightening up the general discipline on melting and casting, of avoiding overheating of the steel, and pouring quickly after melting down. Various additions made to the metal prior to casting failed to yield any significant improvement. These phenomena became extremely serious at one stage and provoked a full investigation. This included a comparison between the gas content of good and bad castings and the bar materials from which they had been produced. The results of this comparison showed that the increase in nitrogen content on remelting can be extremely variable. For example, heats have been made with as little increase as 0.006 per cent., whereas other heats have increased in nitrogen content by 0.02 per cent. Experiments in the type of charge, that is so far as size of material charged into the furnace, the weight of metal melted, and its proximity to the arc, gave no lead to ways of minimizing this increase in nitrogen content.



Critical Nitrogen Content

From this investigation, the opinion was formed that the nitrogen content originally present in the bar stock should be low enough to accommodate any increases likely to arise on remelting. This opinion was supported by experience in the remelting of a number of heats of bar stock of differing nitrogen levels. The scrap for this type of defect alone, from heats of bar stock containing 0.034 and 0.39-per cent. nitrogen respectively, amounted to 20 to 25 per cent. Bar stocks of 0.027 and 0.030-per cent. nitrogen produced scrap castings of the order of 5 per cent. A number of bar stocks of less than 0.024 per cent. nitrogen gave complete freedom from these defects on remelting. It was concluded that it was essential to start out with bar stocks of the order of 0.020 per cent. nitrogen to be quite sure that any increase of nitrogen content would not cause scrap castings. As a result of this work, and a limited experience with other alloys, it seems that the nitrogen content of the bar material is important, and that it is desirable to decide on an acceptable limit of nitrogen in producing the melting stock.

Acknowledgment

Acknowledgment is due to the directors of Hadfields, Limited, for granting permission to publish this paper, and to various colleagues for assistance in the work concerned.

* * *

Vote of Thanks

Mr. R. F. Waindle, in voicing the meeting's thanks to Mr. Walker at the conclusion of his

Investment-casting Experience

lecture, complimented him on the clear picture he had given of his experiences in the investment-casting industry. It was possible, he added, to keep the nitrogen content under 0.02 per cent. in remelted material. Additions such as titanium or vanadium might have beneficial effects, since they formed nitrides, but there was also the attendant danger of "dirty" castings to be considered.

European Investment Casters' Association

Conference at Liège, July 3 to 6

The next Conference of the European Investment Casters' Association is to be held from July 3 to 6 at Liège, Belgium, in the newly built *Palais des Congrès* which provides all modern facilities for such meetings (amplifiers, projection, translation installation). Those who intend to participate are asked to complete and return as soon as possible forms to Mr. P. Mathy, Usines Gilson, La Croyère, Belgium. Early replies will facilitate bookings in the hotels and help with the whole organization.

The organization of the previous European Investment Casters conferences has been made possible by substantial contributions paid by the companies in the host countries. At the 1959 Conference, it was decided that this should not be continued, and that a fund should be established to subsidize future conferences, to pay for the secretarial work and for the costs of printing of the Conference *Proceedings*. The contribution for this fund is set at £15 for each firm, and member-firms who have not yet paid and who intend to take part in this and further congresses, are asked to remit this sum to Mr. B. J. Helders, "*De Industrie*," Vaassen, Holland.

The conference fee is fixed at Bfrs 1,600 (about £12) for the participants (including the informal meeting on Sunday, the banquet, the works visit and a copy of the *Proceedings*) and at Bfrs. 800 (about £6) for the ladies (this includes the full ladies' programme and the banquet).

The competition that has been a feature of previous conferences is to be expanded this year with a small exhibition of investment castings to which the technical Press will be invited on the Tuesday. This will provide an important opportunity for the European investment-casting industry to demonstrate the possibilities and the versatility of the process. All participants should contribute not more than five samples of their products to this exhibition and firms exhibiting will be given the opportunity of briefly describing their castings. As before, a prize will be given for the best castings displayed and for those showing the greatest potentialities for the development of the process.

Provisional Programme

Sunday, July 3, 8 to 10 p.m. Informal meeting in the *Palais des Congrès* (participants and ladies).

Monday, July 4, 9 a.m. at *Palais des Congrès*. Official opening, welcome address (participants and ladies), after which the ladies attend the ladies' programme.

11 a.m. to 5 p.m.: Technical session (with a break for lunch in the *Palais des Congrès*). The British and German group will report on activities with materials and standardization with discussion, and Mr. Mathy will comment on the results of resilience of castings, also with discussion.

Next, a brief business meeting will be held. After a short communication from English and German members on their organization, the following points are to be dealt with: (1) Place and date for the next congress; (2) suggestions for the next congress programme; (3) further activities of the EICC, and (4) report by Mr. Helders on the financial situation.

Tuesday, July 5, 9 a.m. to 1 p.m., *Palais des Congrès*. Technical session—papers to be presented by members.

1 to 3 p.m.: Lunch at the *Palais des Congrès*.

3 to 5.30 p.m.: Exhibition of cast products by members, and prize competition. All member-firms are expected to take part in this exhibition, to which the technical Press will be invited.

7 p.m.: Official banquet at the hotel *Le Clou Doré* (informal dress).

Wednesday, July 6, 9 a.m. to 12.30 p.m. at *Palais des Congrès*.

Technical session, after which will follow the official closing ceremony, to which the ladies are invited. After lunch at the *Palais des Congrès*, a works visit will be organized (for participants and ladies).

Ladies' Programme

Sunday, July 3, 8 to 10 p.m. Informal meeting at the *Palais des Congrès*.

Monday, July 4, 9 a.m. *Palais des Congrès*. Official opening session, after which a visit is organized to the city, followed in the afternoon by a coach tour through the Ardennes.

Tuesday, July 5, 10 a.m.

Boat trip on the River Meuse to the Val St. Lambert, with a visit to the crystal works in this region and to the "*Exposition du veree*"; return by boat to the "*Musee du Verre*" in Liège (approx. 5 p.m.)

7 p.m.: Official banquet in the hotel *Le Clou Doré* (informal dress).

Wednesday, July 6. Free for shopping or visit to the museum (paintings, history, folklore, etc.).

11.30 a.m.: Closing ceremony at the *Palais des Congrès*.

12.30 p.m.; Lunch in the *Palais des Congrès*, followed by a works visit.

Magnesium Industry Meeting

At the invitation of the (British) Magnesium Industry Council, the Spring Meeting of the Magnesium Association of America will be held in the UK towards the end of May, 1960. The membership of the Association includes the majority of American firms interested in magnesium and its alloys, and there are also associate members in Europe. The meeting will open on May 23 with two days' presentation of scientific and technical papers, after which visits will be paid to foundries and works in the Midlands and in the Manchester area, where further papers will be read. About 60 members of the Association, many of them accompanied by their ladies, are expected to attend, and the meeting will also be attended by representatives of the member firms of the Magnesium Industry Council. The president of the Magnesium Association is Mr. Otis E. Grant, president of Magnode Products Inc., and the chairman of the Magnesium Industry Council is Mr. E. Player, managing director of Birmid Industries, Limited.

RUBERY OWEN & COMPANY, LIMITED, who amongst other activities supply components to the motor industry, are considering sites for a "sizeable" expansion in Lanarkshire, Renfrewshire or West Lothian, as they wish to be near the new motor-car factories in Scotland.

International Die-casting Conference

The third International Pressure Die-casting Conference is being organized for the European Pressure Die-casting Committee by the Italian member of the secretariat, the *Istituto Italiano del Piombo e dello Zinco*, with help of the pressure-die-casting section of *Assomet* (the National Association of Non-Ferrous Metal Industries). It is to be held from May 16 to 20 at Stresa, and is expected to be an even greater success than the last which was held in Paris in 1957 and attended by over 300 delegates from 15 countries. Added attractions at the 1960 conference will include displays by the world's leading die-casting machine-makers and an exhibition of European castings in zinc, aluminium and magnesium alloys. A large American attendance is expected as both the American Die Casting Institute, which is sponsoring two papers, and the American Society for Die-Casting Engineers are planning to send teams. The preliminary programme for the conference—extracts from which are quoted below—shows that, as before, two days will be devoted to technical sessions and two days to works visits. Fewer papers will be given at this conference (12 instead of 16) and ample time will be reserved for discussion. A question-and-answer session is to be held on the second afternoon. The papers, all of which have been specially invited by the European Committee, will be sent out about a month before the conference to those who have enrolled. They will be available in French, German and Italian as well as English, the official conference languages.

Provisional Programme of Papers

The following papers are to be presented for discussion:

From USA: "Why Die-casting Dies Heat-check" by E. C. Kron (Doehler-Jarvis Division, National Lead Company); "The Die-casting Research Foundation—a Case-history of Industrial Co-operation" by D. Laine (secretary, ADCI); "The Technique of Gating Zinc Castings" by R. L. Wilcox (metallurgist and manager zinc and silver sales, American Smelting & Refining Company), and "Cost Analysis and Control of Die-castings" by W. A. Gutmueller (Doehler-Jarvis Division, National Lead Company).

From UK: "Identification and Elimination of Defects of Plated Zinc-alloy Die-castings" by J. Edwards and W. A. Haughton (British Non-Ferrous Metals Research Association), and "Durable Plating on Zinc-alloy Die-Castings" by Dr. S. Wernick (secretary, Institute of Metal Finishing).

From France: "Samples for Spectrographic Analysis" by P. Croissant (*Groupement pour l'Avancement des Methodes Spectrographique*), and "Influence of Casting Conditions on the Mechanical Properties of Zinc Alloys" by M. Chevallier (Cie. Deberny, Montier et Peignot) and M. Billing (*Centre Technique des Industries de la Fonderie*).

From Germany: "Spark Erosion in Die-making" by H. J. Schulz (AEG-Elotherm), and "Recovery and Re-use of Scrap arising in Zinc-alloy Die-casting" by Dr. W. Wolf (Metallgesellschaft A.G.)

From Sweden: "Views on the Heat-treatment of Si/Cr/V/Mo Die-Steel" by A. Lundgren (AB, Bofors).

The works visits will give all delegates the opportunity of seeing at least two plants in Northern Italy, such as Necchi or Olivetti. Conference fees amount to about £21 sterling for delegates and £4 for ladies and guests.

Forthcoming Events

APRIL 11

Institution of Production Engineers

Western graduate section: "Research for Consumers, New Aims, New Methods," by J. G. S. H. Mitchell, 7.30 p.m., at the Royal Hotel, Bristol.

Institute of British Foundrymen

East Anglian section: Annual general meeting followed by "An Introduction to Patternmaking in Plastics," by H. G. C. King, 7.30 p.m., in the Lecture Hall, Public Library, Ipswich.

APRIL 12

Institute of British Foundrymen

Slough section: Afternoon visit to the Aylesbury works and laboratories of International Alloys, Limited. (Details from secretary.)

Institute of British Foundrymen

Coventry and district section: Annual general meeting followed by a technical film show arranged by Foundry Services, Limited, 7.30 p.m., at the Coventry Technical College, Room A5.

APRIL 14

Combustion Engineering Association

Midland region: Discussion on "Industrial Space-heating," introduced by F. R. Colton, 10.15 p.m., at the Birmingham Exchange and Engineering Centre, Stephenson Place.

Institute of British Foundrymen

Beds. & Herts. section: Annual general meeting followed by film, "Great Names," produced by F. & H. Lloyd & Company, Limited, 7.30 p.m., at K & L Steelfounders and Engineers, Limited, Letchworth.

Iron & Steel Institute Awards

The Council of the Iron and Steel Institute has announced the award of the following medals and prizes: *Bessemer Gold Medal for* 1960, to Professor Dr. Hermann Schenck, director of the *Institut für Eisenhüttenwesen*, Rheinische-Westfälische Technische Hochschule, Aachen, Germany, and president of the *Verein deutscher Eisenhüttenleute*. *Sir Robert Hadfield Medal for* 1960, to Dr. J. C. Hudson, head of the corrosion section, chemistry department, British Iron and Steel Research Association. *Andrew Carnegie Silver Medal for* 1959, to Dr. P. R. V. Evans, formerly research department, Metropolitan-Vickers Electrical Company, Limited, Manchester, for a paper on the "Effect of Rolling Unstable Austenitic 0.76 per cent. Carbon Steel at 220-300 deg. C." (his co-author, Professor Hugh O'Neill, was not eligible for an award). *Williams Prize for* 1959, to Mr. I. M. D. Halliday, research and development department, United Steel Companies, Limited, Rotherham, for a paper on "Continuous Casting at Barrow"

The awards will be made at the Institute's annual general meeting at the Royal Commonwealth Society, Northumberland Avenue, London, W.C.1, on the morning of Tuesday May 3.

LONG-SERVICE PRESENTATIONS to mark the completion of 25 years' service were made to nine employees of the Sanbra group of companies on March 28 at the works of a member company, Sandwell Castings, of West Bromwich. Amongst the recipients were four employees from the latter company, Miss A. M. Pinson, Mr. W. J. Cashmore, Mr. J. Howse and Mr. A. G. Venables. Other recipients were Mr. C. Faulkes, Mr. A. T. Savage and Mr. J. T. Price, all employed by Sanbra, Limited, of Aston; Mr. W. F. Merricks (Conex-Terna, Limited, Tipton); and Mr. A. E. Williams (Hot Press Products, Limited, Tipton). The presentations were made by the joint managing director of Sanbra, Mr. F. Whitworth.

Notes from the Branches

London

About 70 members and visitors attended the meeting of the London branch of the Institute of British Foundrymen, held on Wednesday, March 23, at the Constitutional Club, London. The lecturer for the evening was Mr. M. M. Hallett, M.SC., F.I.M., and his subject "Review of the Work of the IBF Technical Council on the Effects of Cooling Rate on the Properties of Grey-iron Castings." Several sub-committees of the Institute have worked on such factors as the influence of the mould material on the rate of cooling of castings and the consequential effect on mechanical properties and the influence of changes in the rate of cooling and of variations in stripping practice on internal stresses. The lecture was planned to show the connections between these different activities and to present a summarized picture of the considerable volume of experimental work carried out.

Before Mr. Hallett gave his talk, the branch president, Mr. J. Bain, M.I.MECH.E., in introducing him, said that he had got a very dry subject, so complicated that possibly only a man of the lecturer's calibre could put it across. The discussion which followed indicated that Mr. Hallett had indeed succeeded even beyond his own expectations in making the complex interrelation of the sub-committee's work intelligible to his audience. The questions were both pointed and erudite, showing that those present had well grasped the implications of the work described and were seeking to apply them in the light of their own practical foundrywork.

Discussion

The first questioner said that ordinary foundrymen would like to see these researches carried out by sub-committees of the Technical Council put into practice, for example, as applied to the cooling and camber of large castings. Mr. Hallett replied that the principle developed experimentally from small castings could be related to large ones; unfortunately few practical founders were in a position to offer sizeable castings out of their production as "guinea pigs" for assessing practical applications of the research carried out. He did, however, refer to Mr. E. Longden's work on the cooling and camber of large castings. He had applied differential cooling-rates and included a means of calculating camber. Another member said he was pleased to see the application of different sand grades to give different cooling-rates, and asked where the stress would be in a casting comprising a thin-section pipe with a large flange. He was told that the stress in the cylinder would be the lower and the flange would tend to follow normal cooling law for a disc. Further questions were asked on this subject and another member asked whether the differing physical properties obtained with hard ramming and coarse sand were due to the cooling rate or were functions of the dilation of the mould. Mr. Hallett said this was a very interesting point and he could not give a firm answer. Dilation might have some effect; tables in the sub-committee's report referred to did not indicate direct relation of physical properties to mould hardness—unfortunately, perhaps, the as-cast sizes of the bars were not checked. The mechanism was complex and thermal conductivity of sand definitely increased with ramming density. A further questioner said the findings of Mr. Hughes (BCIRA) were that hard-rammed moulds produced better castings; how could this be reconciled with the sub-committee's results. Mr. Hallett replied that the speaker had got the wrong interpretation of the sub-committee's report and stressed that Mr. Hughes' findings were, in fact, in accord with the sub-committee's findings. Another speaker stated that the degree of nucleation of iron also altered with different cooling-rates. Were the degrees of superheating and pouring temperatures kept constant during the research? Here, Mr. Hallett agreed that superheating and differing pouring temperatures could vitiate results if they were permitted to vary, but in fact in the research referred to, both these factors had been strictly controlled. One member of the sub-committee had travelled from foundry to foundry supervising the tests personally. The opinion was expressed that from the point of view of efficiency, it would appear that square-section bars might yet give better results than round-section (in contradiction of established practice). To this, Mr. Hallett said this would appear to be the case at first sight, but the idea was not wholly proved. Here, another speaker injected the opinion that the taking of photomicrographs from edge to centre of the square and round sections would have proved the point. The lecturer could not confirm that such micro-examinations were conducted on the test castings, but said that even allowing for such variation of structure, consideration of the volume: surface-area ratio should remove discrepancies.

Other Points

In connection with weathering, the speaker's assessment of 7 per cent. maximum alleviation of stress was queried and he was asked if stress relief might be cumulative with time—with particular reference to some spoked-wheel castings which cracked during very cold weather. The reply was that most of the 7 per cent. maximum alleviation of stress during weathering appeared to take place quite quickly and the sub-committee, in fact, had not come out in favour of weathering as a practical proposition. As to the alleviation of stress by skim machining, this, too, seemed to have little basis in fact, but Mr. Hallett did agree that dished castings of thin section could sometimes be straightened by shotblasting—this, in fact, was the result of the application of considerable "work." Replying to other points, the lecturer said that the relation between sand permeability and mould hardness had not been worked out in the report referred to; it might have been interesting to find out what results were obtainable from milling a square test-bar out of a square-section casting; Russian results which were quoted for the success of slush casting in experimenting with steel were quite understandable, the sub-committee's own experiments of this type having failed because cast iron had a "mushy" type of solidification.

Mr. J. R. Booth proposed the vote of thanks, suggesting that members' rapid assimilation of the topic was indeed a great compliment to the speaker. Mr. A. Talbot seconded the proposition, and Mr. Hallett, in acknowledgment, confirmed his appreciation of the discussion and thanked members for their interest.

South Africa

The popularity of a practical paper was again proved at the February meeting of the South African branch, when almost 100 members and guests were present to hear Mr. S. H. J. Wade present his paper entitled "Making a Ship's Propeller." The audience included a large number of apprentices from the local technical colleges.

Mr. Wade described six methods of making a propeller as follow:

Casting as Pattern: The first method described was the use of an existing propeller as a pattern. This necessitates the blocking up of the shaft hole, the fixing of core prints and machining pieces, and the making

of a corebox to provide the correct amount of machining in the propeller boss. A template must also be made for the profile of the blades, to allow for the blades being made larger in the mould to make up for contraction of the metal in which the propeller is being cast. The moulding method is the same as for ordinary castings.

Single-blade Pattern: Another method, for comparatively small propellers, where there is no pattern and the order calls for one or two off, is for the patternmaker to make the boss and a one-blade pattern. The drag is rammed blade by blade, the pattern being transplanted as each section is completed. On the last blade the pattern remains in position for the ramming of the top. The top is then removed, and the pattern again transplanted for the next blade, and so on until the propeller is complete.

Full Pattern: The third method referred to is the use of a full pattern where the order calls for a reasonable number off, usually in cases where the propeller size is reasonably small. Orthodox moulding procedure can be adopted with this method.

Bases with Loose Blades: By this method, a pattern and corebox is made for the boss and a single pattern with a flanged base made for the blades. The blades and boss are moulded separately, and in the subsequent machining operations studs are fixed in the boss, the blades having elongated stud holes, on a radius, which allow the blades to revolve on their bases until their faces are in the correct pitch position for fixing.

Variable-pitch Propeller: This type of propeller has a hollow boss, and loose blades which are controlled mechanically. The method for this type is the same as that in the previous section.

Strickle Method

The sixth method, described by Mr. Wade in detail, is the strickling of large propellers, which, he said, requires the most skill as far as the moulder is concerned. The method described was for a loam mould. The first strickle board prepares the bed to receive the base plate, after which the centre section is built up in brick and loam to elevate the boss to the correct height. The bottom core print is then bedded into the elevated centre section, and the blade centre-lines and helix template marked. With the base plate staked in position, the second strickle is used to strickle off the boss and feeder-head, which have also been built up with brick and loam. After the helix template has been placed in position, a template is placed on the base plate and the size of the bottom mould marked off from the centre-line, provision being made for a landing around the blade profile, to accommodate the top grid.

The third strickle board is counterbalanced by rope from the arm over the swivel pulley on top of the spindle to a weight on the opposite side of the board. This board is used as a guide for the height of the bottom mould, which is made roughly to within an inch of the finished face, the final layer of loam being applied and swept off to contour. A fourth strickle board is used to form the fillet between the face of the blade and boss. Before the helix template is removed, a centre-line is marked off with the strickle board on the face of the mould, this line being picked up from the centre on the helix template. This procedure is carried out for each blade.

The next stage is to mark out the blade profile from a template set in accordance with the centre-lines. On radius lines marked on the bottom mould surface by strickle board, the sectional thickness templates are nailed in their respective positions. These templates are used to form dummy blades which are moulded into shape with a loam surface, a fifth strickle board being used to make the top fillet between blade and boss. After the dummy blades have been dried, individual tops are made with their own cast-iron grids. Feeder-heads are taken off the highest point of each blade.

A top box is rammed up containing the core print, vents and pencil runners, if run from the top. The box and tops are marked before removal for drying. Then, the dummy blades are cut off, the spindle hole rammed-up, and, if facilities are available, the base plate and drag removed to the drying oven as a complete unit. Normal closing and weighting procedure is carried out before casting. Large propeller castings are usually cast from the bottom.

During the course of the lecture, Mr. Wade explained the various methods by means of carefully constructed models, the showpiece being a wood and plaster-of-Paris model of the loam/strickle-type mould, showing the weighted strickle in working order, and dummy blades, etc. The lecture concluded with a film of the strickle moulding of a 10-ton "Meehanite" propeller in the foundry of Globe Engineering Works, Cape Town.

Mr. K. H. Coombs, the branch president, commented on the fact that Mr. Wade had travelled 1,000 miles from Cape Town to give the lecture. He then called on Mr. R. T. Rounce to open the discussion, which was of a particularly lively and interesting nature. Mr. A. B. Anderson then proposed a vote of thanks to the author, and complimented him on an excellent presentation, well supported by first-class models, and particularly on his clear and comprehensive answers to the questions during discussion time. The vote of thanks was heartily applauded.

Branch Programme

In the current session of the South African branch three lectures have already been given, one by Mr. C. Campbell on "Mechanization of the Coreshop," a second by Mr. S. H. J. Wade on "Making a Ship's Propeller" (reported above), and the third by Mr. H. Steinhardt on "Production of Copper-wire Bars." In February the branch visited the works of C. H. Fuchs, Limited, Alberton, and a social evening was also held during the month.

Future events scheduled in the branch programme include the second annual branch conference to be held in Johannesburg on April 21. At this, three papers are to be presented, one of which will be the official exchange paper of the Institute entitled "Work-study" by Mr. C. M. G. Wallwork. The other two papers are by Dr. W. Bleloch on "Current Trends in Stainless-steel Melting Practice" and a "Malleable Cast-iron Foundry" by Mr. J. H. Peers. Another works visit, this time to Escher Wyss Austral Iron Works, Limited, Boksburg, has been arranged for May 18 and on May 26 the annual general meeting is to be held at the Pharmacy House Auditorium, Johannesburg. The session will conclude with the annual dinner at the Langham Hotel, Johannesburg, on June 10.

This year the branch is again holding a Short Paper Competition, the winner of which will be awarded the Alexander Medal and Prize. The competition is open to all grades of members of the IBF, South African branch, and papers, of not more than 1,500 words, on a foundry, patternshop, or related subject will be acceptable. To help those preparing papers, and to encourage others who may wish to enter, the closing date for receipt of entries for the competition has been extended from March 31 to April 30.

Personal

Mr. C. E. MIDDLEMISS has resigned from the board of Clarkson (Engineers), Limited.

Mr. B. SHARP is retiring from Brooke Tool Manufacturing Company, Limited, and has resigned from the board.

Mr. CHARLES JACKSON and Mr. RONALD WILLIAMS have been elected to the board of directors of Bowmaker (Plant), Limited, Willenhall, Staffs.

Mr. W. S. KIRKPATRICK has been appointed a director of Amalgamated Metal Corporation, Limited. Mr. R. E. STAVERT has resigned from the board.

Mr. HENRY ALLEN, industrial relations manager of the Yale & Towne Manufacturing Company, has been made a Justice of the Peace for Staffordshire.

Mr. C. S. THOM, who for many years was sales director of de Havilland Aircraft Company, Limited, is retiring after more than 31 years in de Havilland service.

Mr. WILLIAM B. BROADBENT has been appointed managing director of R. D. Nicol & Company, Limited, a subsidiary of the Staveley Coal & Iron Company, Limited.

Mr. CHARLES V. ARMITAGE, managing director of William Foster & Company, Limited, Wellington Foundry, Lincoln, has retired from that post but will continue as chairman.

Mr. C. M. MARKS, of Hussman British Refrigeration, Limited, has been elected chairman of the British Refrigeration Association and Mr. N. F. T. SAUNDERS, of Kelvinator, Limited, vice-chairman.

Mr. R. P. JANION has been appointed sales engineer of the switchgear division at the Witton Works of the General Electric Company, Limited, responsible for switchgear for voltages of 3.3 kV and above.

Mr. PATRICK BEESLY, assistant managing director of Henry Hope & Sons, Limited, manufacturers of steel, bronze and aluminium casements, Halford Works, Smethwick, has been appointed joint managing director.

To mark the completion of 50 years' service with the Isca Foundry Company, Limited, Newport, Mon, Mr. I. E. WALL, chief draughtsman, has been presented with a Queen Anne coffee table by the directors and his colleagues.

Mr. IVON A. BAILEY has been appointed deputy chairman of the Mond Nickel Company, Limited, and of Henry Wiggin & Company, Limited, and Mr. EDWARD VAUGHAN has been appointed a director of both companies.

Mr. JOHN GIBB, managing director of Carntyne Steel Castings Company, Limited, Renfrew, Scotland, retired from executive duties on March 31, but remains on the board as a non-executive director. His successor is Mr. JAMES BRENNAN.

To mark his retirement after 41 years' service with the Park Gate Iron & Steel Company, Limited, of Rotherham, Mr. FREDERICK WOODFIELD, assistant managing director, received a presentation from Mr. C. H. T. Williams, managing director of the company.

At the annual general meeting of the Non-Ferrous Club the following officers were elected for the ensuing year: As president, Mr. P. MOULD; as chairman, Mr. R. L. DEUTSCH; as secretary, Mr. L. B. Wright; as treasurer, Mr. A. E. TEASDALE, and Mr. G. E. LEWIS is Press officer.

Mr. A. PRESSLEY, a sectional manager of Thos. W. Ward, Limited, received presentations on behalf of the directors and staff colleagues to mark the completion of 25 years' service with the firm on April 1. Mr. Pressley joined the firm straight from school and has worked in several departments.

Mr. FRANK M. RYAN, director of Norton Grinding Wheel Company, Limited, Welwyn Garden City, and vice-president and general manager of Norton International Inc. has retired after more than 46 years with the company. Earlier in his career he was for a time works manager of the English factory.

Mr. CHARLES CRABTREE, chairman of R. W. Crabtree & Sons, Limited, printing-machinery manufacturers, Leeds, is on a business tour of the United States, Canada, Australia and New Zealand. With him on the tour are Mr. H. E. BIRKINSHAW, the company secretary, and Mr. MALCOLM LOUGEE, the technical director.

Two employees with a total of 87 years' service with W. & T. Avery, Limited, Smethwick, have been presented with retirement gifts by Mr. F. M. Woodcock, director and sales controller. They are Mrs. A. BRIGGS, aged 60, who joined the firm in March, 1915, and Mr. W. L. W. PRIESTMAN, aged 65, who retired after 42 years' service.

Mr. RALPH LOVELL, managing director of Oakes, Turner & Company, Limited, gold and silver refiners, Eyre Street, Sheffield, was installed as president of the Sheffield Junior Chamber of Commerce on March 23. Mr. Lovell joined Oakes, Turner in 1953 from Johnson Matthey & Company, Limited, Hatton Garden, London, the parent body of the Sheffield firm.

Among the new officers of the Industrial Association of Wales and Monmouthshire are Dr. A. G. RAMSAY, resident director and general manager of the Mond Nickel Company, Limited, Clydach, Swansea, who was elected senior vice-president, and Mr. DAVID J. YOUNG, secretary of the Steel Company of Wales, Limited, elected junior vice-president for South Wales.

Mr. G. F. ASHFORD has been appointed deputy chairman of the chemical group of the Distillers Company, Limited, as from April 1. Mr. J. M. Rimington, managing director of the chemical division, retired on that date for reasons of health after 30 years' service, and is succeeded by Mr. J. H. DUNN. Mr. J. S. HUNTER succeeds Mr. Dunn as assistant managing director (commercial) of the chemical division.

Obituary

The death has occurred of Mr. DENIS RHODES at the age of 74. Mr. Rhodes was, until his retirement in 1948, chairman of Renold Chains, Limited, of Manchester.

The death occurred on March 26 of Mr. ALBERT WILLIAM HEALEY, production manager of John Smith & Company (Derby), Limited, engineers and brassfounders. Mr. Healey was 58.

Alderman J. LOUIS BROOK, Mayor of Huddersfield, and vice-chairman of Brook Motors, Limited, electric-motor manufacturers, Huddersfield, died suddenly on March 26. The company was founded by his brother, the late Mr. Ernest Brook. Alderman Brook had been a member of Huddersfield Town Council continuously since 1942 and an Alderman since 1955. He was 79 years old. He was awarded a Coronation Medal by the Queen in 1953, a year after he had been Deputy Mayor.

News in Brief

OUZLEDALE FOUNDRY, LIMITED, of Barnoldswick (Yorks), are to instal two new cupolas to obviate complaints of fumes and grit being carried to the nearby Coates housing estate.

AT THE "PRODUCTION EXHIBITION," to be held at Olympia, London, from Monday, April 25 to Saturday, April 30, Stand No. 65 has been taken for staging an exhibit by the National Foundry College.

AT THE International Pressure-die-casting Conference at Stresa next May, Peco Machinery Sales (Westminster), Limited, will be represented by Mr. E. GASPAR, chief designer, and Mr. J. BRUCE of the sales department.

JESSHOPE, LIMITED, the Longport (Staffs) ironfounders and engineers, are building a new factory at Chesterton at a cost of about £500,000. Eventually, the new works will provide employment for about 1,000 people.

SIX VISITORS from Russia, all specialists in car and motor-cycle production, recently visited the factory of the British Motor Corporation, Limited at Longbridge, Birmingham. The visit was arranged at the request of the Russian Embassy in London.

MOORWOODS, LIMITED, Sheffield, a member of the Brightside group of companies, has secured a contract valued at about £50,000 for installation of the complete galley and pantry on board the new Savill and Albion passenger ship being built at the Vickers-Armstrongs, Limited, Walker Yard at Newcastle.

FOLLOWING TALKS in Addis Ababa between the USSR and Ethiopia, a protocol on Soviet assistance in the building of a number of industrial projects and in comprehensive geological surveys in Ethiopia has been signed. It provides *inter alia* for surveys to determine the possibility of building an iron and steel plant with a Soviet loan.

THE NATIONAL STEEL FOUNDRY (1914), LIMITED, Leven, Fife, are prepared to extend their premises and instal plant to manufacture components for firms in the general engineering field. This move, which would provide more employment in the area, was disclosed by Mr. Arthur Marsh, works manager, at a public meeting on March 30.

BAKER PERKINS, LIMITED, of Peterborough, have secured a contract for the supply of pneumatic handling and mixing equipment to be installed at the Shell Chemical Company's new polyolefines plant at Carrington, near Manchester. The contract is worth nearly £500,000. The main contractors for the plant are Matthew Hall & Company, Limited.

A SOLIDS MASS SPECTROMETER, supplied by Metropolitan-Vickers (now Associated Electrical Industries (Manchester), Limited) has been installed at the research and development department of the Mond Nickel Company, Limited, at its Birmingham laboratory. In June, the department took delivery of an automatic X-ray fluorescence spectrometer manufactured by Solartron, Limited.

THE JOURNAL gratefully acknowledges the 1960-61 Metropolitan-Vickers well-known "Girl Calendar" sent in by Associated Electrical Industries, Limited. The Eyre Smelting Company, Limited, has also published as usual their calendar out of season, and this takes the form of a quite pleasing presentation based on British sporting events. A diary of these events is also included in the format.

THE 49-YEAR-OLD New Zealand Government steamer Earnslaw, plying on Lake Wakatipu, will continue in service for some years yet. Plans to replace her were made three years ago, but have been shelved. Built at Dunedin in 1911, the 300-ton vessel was taken in sections to Lake Wakatipu and assembled there. She is the only coalburning vessel left in New Zealand waters, and is operated by New Zealand Railways.

THE NEXT COURSE OF LECTURES on "Industrial and Factory Law," to be given under the auspices of the Industrial Welfare Society, will be held at Robert Hyde House, 48 Bryanston Square, London, W.1, on May 10-12, when the lecturer will be Mr. Harry Samuels. In view of recent legislative changes the lectures are also intended to serve as a refresher course. Further particulars can be obtained from the administrative officer of the Society at the address quoted.

AN INTERNATIONAL POWDER METALLURGY CONFERENCE is to be held in New York, from June 13 to 15. Among the papers listed three will come from England. "Dispersed Phase Systems," by Dr. I. Jenkins (General Electric Company, Limited); "Properties of Nickel-containing Dispersed ThO_2," by Mr. D. K. Worn, Mond Nickel Company, Limited); and "Heat-resisting Materials by Powder Metallurgy." by Mr. J. F. Watkinson and Mr. V. A. Tracey (B.S.A. Research Centre).

JOHN READHEAD & SONS, LIMITED, shipbuilders, South Shields, have received a £1,000,000 shipbuilding order from Frank C. Strick & Company, Limited, London. A berth reservation was placed some time ago by the London firm, and a cargo vessel of 12,800 tons deadweight is to be built for them. The vessel will be completed by the summer of 1961. This is the third order announced by John Readhead this year and should ensure employment at the yard for about two years.

THE GOVERNMENTS of both countries have approved an Anglo/German agreement for the joint development of small jet-aircraft engines. The firms concerned are Rolls-Royce, Limited, and Maschinenfabrik Augsburg-Nuernberg A.G., of Augsburg. The agreement will enable the high cost of development of these engines to be shared, thus widening the range of engines available for commercial export by the United Kingdom, and furthering the movement towards co-operation within the European aircraft and engine industry.

NEW ZEALAND MINISTER OF ELECTRICITY, Mr. Watts, has stated that tenders are to be called in the very near future for the six generators for the Benmore hydro-electric station, the largest to be built in New Zealand. He said the orders for the machines would be offered in an entire group of six, or alternatively, for construction of just two generators, by any one manufacturer. Each machine will be of 90,000 kw capacity —more than twice that of the large Roxburgh generators. (The generators for Roxburgh were made by a British company, while the turbines were supplied by a Canadian combine.)

THE 600 WORKERS at the Halesowen factory of G. Clancey, Limited, ironfounders, of Belle Vale, Worcs., have given up their tea break in order to work four hours fewer each week. On Monday, March 28, they began a 40-hour week compared with the previous 44-hour period. They have not lost their cup of tea for this is being brought round to them in the factory on trolleys. A factory spokesman said: Although we shall have to provide more labour to take the tea round the factory we think the new scheme will work well. A ten-minute tea break can sometimes stretch into a quarter of an hour or 20 minutes. The new working arrangement is two hours less than the national agreement of a 42-hour week.

News in Brief

ORDERS WORTH ALMOST £1,000,000 have been obtained recently by Bruce Peebles & Company, Limited, electrical engineers, Edinburgh. Due to be delivered in 1961 and 1962, they include two transformers to be used in the supply of electricity to the new steel strip mill of Colvilles, Limited, at Motherwell. Other orders recently secured by the company are four 240 mva auto transformers for the South of Scotland Electricity Board; four 60 mva transformers for transmission points in the Glasgow area; and two 90 mva transformers for Ravenscraig. Two more transformers are to be built for the Cwm Rheidol and Dinas hydro-electric stations in Wales and two have been ordered by the North of Scotland Hydro-Electric Board for their Aigas and Kilmarnock stations.

EMPLOYERS ARE REMINDED by the Ministry of Pensions and National Insurance that those who wish to contract out of the new graduated pension scheme but who do not apply in sufficient time will have to pay graduated contributions from April, 1961, when collection of these contributions starts, until such date as a certificate is issued and takes effect. Applications to the Registrar of Non-Participating Employments for a certificate may be made at any time, whether before or after April, 1961, but employers who wish to have certificates in force by then should allow sufficient time in making their application for the Registrar to deal with them. In cases where a certificate, even though applied for, has not been issued, graduated contributions will be payable from April, 1961, until such date as the certificate is issued and takes effect.

AUTOMATION IN INDUSTRY was discussed by Mr. W. Goslin, a lecturer at Swansea University, at Nottingham Cosmopolitan Debating Society on March 27. Giving his own definition of the term, he said that when physical labour was replaced by a machine, that was mechanization; when mental labour was replaced, that was automation. Mr. Goslin said, "Sometimes it is cheaper to employ a person to do a job than a machine, but computers will replace people on anything where large arithmetical sums have to be calculated—such as pay-roll and income tax calculations." In the long run, he said, he welcomed the computer, and although the transition to a mechanized society would be painful and costly, yet it would be to the benefit of all. If a man became redundant through such a machine, he was performing a social service and must not be made to pay for the consequences himself.

IN SHEFFIELD there were nearly 700 students and trainees from overseas, said Sir Paul Sinker, director-general of the British Council, presiding at the opening of Sheffield's new International Centre in Broomhall Road. He said this financial year the British Government had spent £140,000,000 on technical and financial aid to countries overseas. In addition to this contribution by the taxpayers, private investors had spent £100,000,000. Sir Paul said this assistance to other countries fulfilled an economic and moral obligation. If Britain could help to raise the standard of living in other countries, in the long run this country's trade would benefit. Sheffield, he said, played a leading part in achieving these ideals. Cash by itself was not sufficient—it was essential to provide technical training on a large scale. The Centre, open to students and trainees from overseas, was officially opened by the Lord Mayor of Sheffield, Alderman A. V. Wolstenholme.

Prof. W. GRANT IRESON, executive head of the Department of Industrial Engineering, Stanford University, California, and temporarily engaged as a consultant on industrial engineering by the European Productivity Agency, will conduct a series of seminars in Britain from April 28 to June 10. The first of the seminars will concern the basic concepts of industrial engineering; the second will deal with economic analysis, and the third with factory planning, procedures and techniques. The first seminar will be held in London on April 28-29; Professor Ireson will be in Liverpool for the second series seminar from May 26 to 27 and in Birmingham from May 30 to 31. London will again be the centre for the third series from June 7 to 8 with a seminar incorporating all the subjects of the three series, staged at Bristol from May 9 to 12. It is presumed that details of these meetings are available from the British Productivity Council, 21. Tothill, Street, London, S.W.1.

Aluminium Sales reach a New Record

Demand for aluminium showed substantial growth in 1959 and free world consumption rose to record levels, said Mr. Nathanael V. Davis, president of the Canadian company, Aluminium, Limited, in a message to shareholders in the company's annual report. He said that the 1959 figures were about 20 per cent. higher than the previous record in 1956 and that in the middle of the year a turning point was reached in the return to improved aluminium markets.

The company's Canadian aluminium smelters were currently operating at about 90 per cent. of the rated capacity. Sales and operating revenues last year were $448,700,000 compared with $422,900,000 in 1958. Consolidated sales of aluminium in all forms in 1959 were 643,328 (581,195) tons. In the fourth quarter, sales reached a record 200,000 tons which, Mr. Davis said, was believed to reflect some inventory buying in anticipation of a price rise.

Consolidated net profit was $24,000,000, or 79 cents a share, which Mr. Davis described as a "modest improvement" over the $22,464,510, or 74 cents a share, in 1958. During 1959, the company spent $62,000,000 on new plant and facilities, a decrease from $103,000,000 in 1958.

Stanton Ironworks Long-service Presentations

Gold watches were presented to 93 male employees with over 30 years' service and to two female employees with 25 years' service by Mr. N. C. Macdiarmid, managing director of the Stanton Ironworks Company, Limited, Nottingham, on March 25. Since the first such presentation was held in 1952, 2,029 gold watches have been presented.

Mr. A. Savage, an overhead electric-crane driver, received the two-thousandth watch, and of the recipients at the last presentation 69 are employed at the Stanton Works, 21 at the Holwell Works at Melton Mowbray, and three at Cochranes Works, Middlesbrough.

National Engineering Laboratory

Facilities for sponsored investigations for industry will be on show at the National Engineering Laboratory, East Kilbride, Glasgow, on June 15 and 16.

During the open days, the results of work carried out as part of NEL's general programme of basic research, including research into the cold extrusion of steel, the automatic measurement of errors in machine tools, and studies of the performance of high-speed bearings will be displayed, as well as investigations into the growth of fatigue cracks.

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Raw Material Markets

Iron and Steel

There is a brisk demand for most grades of pig-iron and overall production continues at record levels. Makers of basic pig-iron are able to dispose of their outputs fully to the steelworks whose requirements are on an increasing scale. In the foundry grades of pig-iron, outputs have been stepped up to meet the increased call for supplies of the low phosphorus pig-iron and hematite, both of which are in heavy demand.

The engineering and speciality foundries are using substantial quantities of both grades for their high outputs of high-duty castings and large quantities of hematite are also needed for the production of ingot moulds and castings for the steelworks. Some brands of the low phosphorus irons and hematite are still difficult to obtain owing to limitation in supply, but from the several sources now available the foundries are able to cover their needs for both current and forward bookings. The latter are on the increase as users are anxious to earmark for sufficient supplies to cover the work on hand. Where refined irons are utilized, these are being supplied to requirements. Outputs of the high phosphorus irons are adequate to satisfy the call from the light, jobbing, textile, and from some of the engineering foundries which require supplies of this iron.

Apart from collieries and railways, the demands from the trades which use high-duty castings continue at high levels. The foundries catering for the motor vehicle trade are very busy, and there is no relaxation in the call for castings.

The increased call for builders' castings is maintained and this is expected to show continued seasonal improvement, while fairly good demands are also being made from the domestic utensil trade. The light foundries supplying to these trades are fairly well engaged, but capacity is available for additional work. The call for high phosphorus foundry pig-iron from these foundries is not in proportion to their outputs of castings as they are using a high percentage of scrap in their mixtures. Most of the jobbing foundries have fairly good order-books, although at these and also the textile foundries more work is needed.

The foundries are able to secure most of the scrap they require, although there is a persistent demand for the better and heavier grades of cast-iron and machinery scrap.

An active demand continues for all the products of the re-rollers including small bars, light sections, and reinforcing rods. The orders now on hand will keep the mills fully occupied for some weeks ahead at capacity levels, providing adequate labour and supplies of steel semis can be obtained.

The shortage of suitable labour is a limiting factor in their production, which is also being adversely affected by the difficulty in securing all the steel semis required, particularly in 2-in. billets. Home steelworks are sending forward substantial tonnages, but these are well below demands. All arisings at the steelworks of suitable re-rolling defectives and crops are readily taken up.

Non-ferrous Metals

Stocks of copper held in London Metal Exchange official warehouses fell last week by a further 200 tons to 1,849 tons—the lowest total since February, 1956. This low level is helping to hold up London copper prices, but the market is now coming under some other bearish influences which, on balance, will most probably initiate a downward trend in prices.

US copper is now on offer for May delivery in the UK and this is blunting the impact that the shortage of stock might otherwise have had on the market. The situation in South Africa, however, is calmer and informed opinion no longer feels that the disturbances will affect Rhodesia and copper production. Finally, demand from the Continent has fallen away. In these circumstances the outlook is for the market to turn down and the backwardation to close up.

In the US, consumer demand is still not good and with the industry now running at full capacity the outlook on that side of the Atlantic is for a fall in prices and an increase in stocks. At present custom smelters and producers continue to quote 33 cents a pound. However, dealer copper is being offered at a slight discount below this level and it is noted that the US export price is quoted at around 31½ cents a pound.

Tin is quietly steady in London. The somewhat featureless market condition being attributed to the end of the first quota period. In addition, on March 31 the offering on the Singapore tin market was 270 tons, the highest since July, 1958. The size of the offering was said to be due to the miners clearing stocks on the last day of the quota period. During the tenth control period, which began on April 1, Malaya may export 14,156 tons. In the US the market is quiet and the price is still fluctuating fractionally below $1 a pound.

Lead in London continues to be a firm market and the price levels have been well held. The US market is dull and with stocks rising and demand falling, particularly from the automobile industry, the whisper is going around that a price reduction may soon be in sight. At present the New York spot price is unchanged at 12 cents a pound.

Zinc has been an uneven market because of the prospects of a metal squeeze but this fear has now receded completely. In the US the market is quiet and the price unchanged at 13 cents a pound.

Lord Hailsham visits BISRA

Lord Hailsham, the Lord Privy Seal, visited the Hoyle Street laboratories of the British Iron and Steel Research Association on March 30, in the course of his recent tour of the Sheffield area. In view of his special responsibility for scientific matters, the Department of Scientific and Industrial Research arranged the BISRA visit, in conjunction with the Association.

Lord Hailsham, who was accompanied by Sir Harry Melville, secretary of the DSIR, was received by Dr. Charles Sykes and Sir Charles Goodeve, chairman and director of BISRA respectively, and Dr. J. Pearson, assistant director and head of the Hoyle Street Laboratories. The visitors saw a number of projects, which included work on vacuum melting, the "APIC" device (automatic power input control) for arc furnace use, and a recently announced automatic forging project.

Lord Hailsham was particularly interested in the work on the continuous casting of steel being carried out by BISRA. A commercial plant for producing continuously cast slab by the BISRA process is to be built at the new extension of the Steel Company of Wales' works at Port Talbot in the next few months. Expressing his deep interest in the research projects he had been shown, Lord Hailsham said "I always like to take the opportunity, whenever possible, of seeing something of the work of the co-operative research associations which are such a vital element in our overall research effort."

Baker Perkins Machinery at work . . . . . *at Peter Brotherhood Ltd.*

Peter Brotherhood Ltd. use this 'Cadet' Rotary Table Shot Blast Machine for a wide range of application at a high production rate. Note especially the control desk which includes signal lights, 24 volt current socket for inspection and ammeters indicating the shot output of the impeller. The wiring circuit is arranged for automatic operation to cut out human errors.

Baker Perkins Ltd.

Engineers

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HISTORICAL NOTE

Peter Brotherhood Ltd. were established in London in 1868. In 1907, the works was transferred to Peterborough, Northants. In their Foundry, they produce a wide range of general engineering castings for air and gas compressors, steam turbines, steam engines, refrigeration plant, water turbines, chemical filtration plants, textile machinery, brewery machinery, and many other applications

Current Prices of Iron, Steel, and Non-ferrous Metals

(Delivered unless otherwise stated)

April 6, 1960

PIG-IRON

Foundry Iron.—No. 3 IRON, CLASS 2, 10-ton lots or over: Middlesbrough, £21 6s. 0d.; Birmingham, £20 18s. 3d.

Low-phosphorus Iron.—Over 0.10 to 0.40 per cent. P, 10-ton lots or over, £23 5s. 0d., delivered Birmingham, £23 10s. 0d., delivered Grangemouth.

Cylinder and Refined Irons.—North Zone, £25 6s. 6d.; South Zone, £25 9s. 0d.

Refined Malleable.—P, 0.10 per cent. max.; North Zone, £26 6s. 6d.; South Zone, £26 9s. 0d.

Hematite.—Si up to 2 per cent., S. & P. over 0.03 to 0.05 per cent., 10-ton lots or over: N.-E. of England (local iron), £23 19s. 0d.; Scotland (Scotch iron), Zone S.1, £24 5s. 6d.; Sheffield, £25 7s. 6d.; Birmingham, £25 14s. 0d.; Wales (Welsh iron), £23 19s. 0d.

Basic Pig-iron.—£20 3s. 0d., delivered Staffs, Derbyshire, Notts, Lincs, Rutland, Northants, and Leicestershire in 10-ton lots or over.

FERRO-ALLOYS

(Per ton unless otherwise stated, delivered)

Ferro-silicon (6-ton lots and over).—45 per cent. Si, £41 10s. 0d. to £44 0s. 0d., scale 15s. 0d. per unit, lumpy; 75 per cent. Si, £57 0s. 0d. to £62 10s. 0d., scale 15s. 0d. per unit, lumpy.

Ferro-Vanadium.—50/60 per cent., 22s. 6d. per lb. of V.

Ferro-molybdenum.—65/70 per cent., carbon-free, 12s. 10d. per lb. of Mo.

Ferro-titanium.—20/25 per cent., 2-3 per cent. Cu, £250 0s. 0d.; 38/40 per cent., commercially carbon-free, £287 0s. 0d.

Ferro-tungsten.—80/85 per cent., 11s. 8d. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 14s. 8d. per lb. of W.

Ferro-chrome (6-ton lots and over, lumpy).—4/6 per cent. C, £78 10s. 0d. to £82 10s. 0d., basis 60 per cent. Cr. scale 26s. 0d. to 28s. 6d. per unit; over 6 per cent. C, £77 0s. 0d. to £80 10s. 0d., basis 60 per cent. Cr, scale, 26s. 0d. to 28s. 6d. per unit; 2 per cent. C,* 1s. 8d. to 1s. 11d. per lb. Cr; 1 per cent, C,* 1s. 8½d. to 1s. 11½d. per lb. Cr; 0.15 per cent. C,* 1s. 9½d. to 2s. 0½d. per lb. Cr; 0.10 per cent C,* 1s. 9½d. to 2s. 0½d. per lb. Cr; 0.06 per cent. C,* 1s. 10½d. to 2s. 1d. per lb. Cr.

Metallic Chromium.—98/99 per cent., 6s. 10d. per lb.

Metallic Manganese.—94/96 per cent., carbon-free, £275 0s. 0d.; 96/98 per cent., £285 0s. 0d.

Ferro-columbium.—65/67 per cent., Cb + Ta, 19s. 9d. per lb., Cb + Ta.

Ferro-manganese (Standard).—78 per cent., £63 10s. 0d.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms, and Slabs.—BASIC: Soft u.t., 100 tons & over, £31 15s. 6d.; tested, 0.08 to 0.33 per cent. C, 6 to 35 tons, £33 15s. 6d.; hard (0.41 to 0.60 per cent. C), under 10 tons, £34 17s. 0d.; silico-manganese, under 10 tons, £43 16s. 6d.; free-cutting, under 10 tons, £36 14s. 6d. SIEMENS MARTIN ACID (under 10 tons): Up to 0.25 per cent. C, £41 1s. 0d.; silico-manganese, £44 4s. 0d.

Billets, Blooms, and Slabs for Forging and for Stamping (under 10 tons).—Basic, soft, up to 0.33 per cent. C, £38 10s. 0d.; basic, hard, over 0.41 up to 0.60 per cent. C, £39 12s. 6d.; acid, up to 0.25 per cent. C, £43 4s. 0d.

* Average 68–70 per cent.

FINISHED STEEL

Heavy Plates and Sections (1 ton to 10 tons).—Ship plates (N.-E. Coast), £41 12s. 0d.; boiler plates (N.-E. Coast), £44 2s. 0d.; floor plates (N.-E. Coast), £43 10s. 0d.; angles (N.-E. Coast), £38 16s. 6d.; joists (N.-E. Coast), £38 12s. 6d.

Small Bars, Sheets, etc.—Rounds and squares, under 3 in., and flats 5 in. wide and under, untested soft basic, 50 tons and over, £39 1s. 0d.; under 10 tons to 4 tons, £40 18s. 0d.; under 4 tons to 2 tons, £41 3s. 0d.; hoop and strip, coils, 100 tons and over, £38 0s. 0d.; uncoated strip mill coils, hot rolled, under 3 mm. to 12g., 25 tons to under 50 tons,, £43 16s. 0d.; black sheets (hand mill), 24g., 10 tons and over. £57 14s. 6d.; galvanized corrugated sheets, 24g., 10 tons and over, £68 5s. 0d.

Alloy Steel Bars.—1 in. dia. and up: Nickel, £68 10s. 0d.; nickel-chrome, £99 4s. 0d.; nickel-chrome-molybdenum £111 17s. 0d., in lots of 5 tons to under 10 tons.

NON-FERROUS METALS

Copper.—Cash, £253 10s. 0d. to £254 0s. 0d.; three months, £240 10s. 0d. to £240 15s. 0d.; settlement, £254 0s. 0d.

Copper, Tubes, etc.—Solid-drawn tubes, 2s. 5½d. per lb.; rods, 271s. 0d. per cwt. basis; 20 s.w.g., 306s. 0d. per cwt.

Tin.—Cash, £791 10s. 0d. to £792 0s. 0d.; three months, £786 0s. 0d. to £787 0s. 0d.; settlement, £792 0s. 0d.

Lead (Refined Pig).—First half April, £78 0s. 0d. to £78 5s. 0d.; first half July, £77 2s. 6d. to £77 5s. 0d.

Zinc.—First half April, £91 10s. 0d. to £91 15s. 0d.; first half July, £89 12s. 6d. to £89 15s. 0d.

Zinc Sheets, etc.—Sheets, 15g. and thicker, all English destinations, £125 15s. 0d.; rolled zinc (boiler plates), all English destinations, £123 10s. 0d.; zinc oxide (Red Seal), d/d buyers' premises, £102 10s. 0d.

Brass Tubes, etc.—Solid-drawn tubes, 2s. 0½d. per lb.; sheets to 10 w.g., 220s. 3d. per cwt.; wire, 2s. 10½d.; rolled metal, 220s. 3d. per cwt.

Brass (Brazing).—BS1400, B3, £166; B6, £220.

Brass (High Tensile).—BS1400, HTB1, £197; HTB2, £216; HTB3, £229.

Gunmetal.—BS1400, LG2, £208; LG3, £218; G1, ½%, £276; G1, 1%, £263.

Phosphor Bronze.—BS1400, PB1 (AID released), £305; BS1400, 90/10/1, £293.

Leaded Phosphor Bronze.—BS1400, LPB1, £229.

Phosphor Bronze Strip, etc.—Strip, 311s. 9d. per cwt.; wire, 4s. 3d. per lb.; rods, 3s. 6½d.; tubes, 3s. 6½d.; chill cast bars, solids 3s. 5¾d.; cored 3s. 6¾d. (CHARLES CLIFFORD, LIMITED).

Nickel Silver, etc.—Rolled metal, 3 in. to 9 in. wide × 0.056, 4s. 0d. per lb.; round wire, 10g. in coils (10 per cent.), 4s. 5d.; special quality turning rod, 10 per cent., ½ in. dia., in straight lengths, 4s. 4d. All prices are net.

Other Metals.—Magnesium, ingots, 2s. 2½d. to 2s. 3d. per lb. Antimony, English, 99 per cent., £190 0s. 0d. Quicksilver, ex-warehouse, £70 10s. 0d. to £71 0s. 0d. Nickel, £600 0s. 0d. Aluminium, ingots, £186 0s. 0d.; aluminium bronze (BS1400), AB1, £255; AB2, £263.

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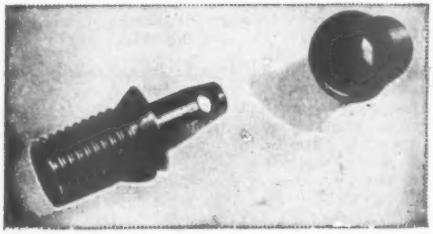
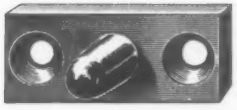


FOR WOOD PATTERNS



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Publications Received

Lloyd's Register of Shipping, Annual Report for the Year, 1959, published from 71, Fenchurch Street, London, E.C.3.

This issue commemorates the bi-centenary of the first issue of Lloyd's Register of Shipping and, fittingly, the earliest record now in existence (published in 1765) is reproduced on the cover. The opening article by Mr. Kenneth R. Pelly, entitled "Double Century," makes very fascinating reading. One thing learnt was that there was no connection between Lloyd's Register of Shipping and Lloyd's, the great insurance house, except they were both born at Edward Lloyd's Coffee House in the City of London.

In the Engineering section, under "Metals," a number of interesting data are reported. For example, oxygen in steelmaking, continuous casting of steel and special steels are commented upon, following a note on the unification of the requirements of the classification societies for steel used in ship construction. It appears that in 1959, five Japanese and two Indian works were added to the list of steelworks approved by the committee after inspection, in addition to others in the UK and other European countries. Owing to shipbuilding being at a lower level in the year ended June 30, 1959, ship- and boiler-steel tested under supervision amounted to only 2.2 million tons compared with over 3 million tons in the previous twelve months. The Society's surveyors inspected over 900 tensile testing machines during the year and 180 machines were added to their approved list. Further notes concern light alloys and cast iron. Under the former, mention is made of extended applications of aluminium-alloys in recent months, particularly for the superstructures of a number of large ships. On the subject of cast iron, it is stated that with the addition of ten foundries in 1959, there are now 44 approved by the Society for the production of so-called "ductile" irons. Demand for these metals is said to be increasing, a number of engineers substituting the material for parts previously made in mild steel. A final note in this section indicates that the behaviour of cast irons at temperatures higher than those previously allowed for these metals is now being investigated. Indications are that the range of temperatures may be extended beyond those formerly regarded as the permissible maximum and it is probable that changes in this respect may take place in the future.

The report is beautifully illustrated and carries quite a few imposing pictures of castings, *e.g.*, a 30-ton propeller made in Scotland and a cast-steel sternframe (14 tons) and crank-web (8 tons) manufactured in Spain. Recipients of this publication can indeed count themselves fortunate.

Guide to Aluminium. Issued jointly by and available from the Purchasing Officers Association, Wardrobe Court, 146a, Queen Victoria Street, London, E.C.4, and the Aluminium Development Association, 33, Grosvenor Street, London, W.1, price 3s. 6d. postage paid.

This 32-page booklet contains a series of articles by Mr. L. V. Chilton, M.A., F.INST.P., which appeared in *The Purchasing Journal* July-October, 1959, issues with the object of giving purchasing officers a background and market view of the many facets of industry which aluminium serves and of the forms in which it is available. When the information had been brought together it was felt to be of such general interest as to warrant its being made available to a wider readership. The booklet, while not pretending to be comprehensive, will undoubtedly serve as an adequate introduction to the subject, and make a valuable addition to educational publications for both teacher and student. The contents include: (1) Ores and production methods; (2) properties and methods of use of aluminium and its alloys, and (3) major fields of application of aluminium (including transport, building and structural engineering, packaging and containers, electrical, food, etc.).

Symposium on Pilot Plants in Metallurgical Research and Development—Jamshedpur, India.

This symposium, held in the National Metallurgical Laboratory, in Jamshedpur, India, from February 15 to 18, attracted a number of well-known metallurgists from all over the world. It was inaugurated by Professor M. S. Thacker, director-general, Scientific and Industrial Research (India); Sir J. J. Ghandy, chairman of the Executive Council of the National Metallurgical Laboratory, presided. Professor Thacker also officially opened the new Pilot-plant Technological Building of the Laboratory, and in doing so acknowledged a gift of over one-million-rupees' worth of equipment from Her Majesty's Government. No fewer than 27 papers were presented and discussed during the course of the symposium, and the proceedings concluded with a dance and variety entertainment organized by the National Metallurgical Club.

Technical Colleges and their Government. Published by the Federation of British Industries, 21, Tothill Street, London, S.W.1; price 5s.

Many foundry executives serve on the governing body of their local technical colleges, whilst many others will, no doubt, be called on in the next few years similarly to participate. This booklet is specially useful alike to those of long-standing membership and to newcomers, as in it they will find recommendations for making the work of governing bodies more effective. Much of the information printed in the booklet is, or should be, well known to those interested in education, but it is good to have it assembled in handy form.

New Catalogues

Overhead Handling Equipment. British MonoRail Limited, Wakefield Road, Brighouse, Yorks., in *Bulletin* No. 23, describe and illustrate a wide range of monorail handling equipment. If the objective of this brochure be the instilling of confidence of the firm's products in the minds of potential buyers, it has well succeeded in its aim, as not only the major components carry detailed technical descriptions, but also the smaller (but equally important) ones. The list of users also inspires confidence and amongst foundry users, the brochure carries pictures of installations at the Ford Thames Foundry and K. & L. Steelfounders and Engineers, Limited. The brochure runs to 16 pages and good use has been made of colour printing especially to bring into prominence the monorail systems set amongst roof girders.

High-duty Iron Castings. S. Russell & Sons, Limited, Bath Lane, Leicester, have released three leaflets covering, spheroidal-graphite iron, Ni-Resist austenitic cast iron and a new heat-resisting material for castings known as "Spheronic." The first leaflet illustrates and describes the 34-ft. dia. caps for the two 450-ft. high chimneys at the High Marnham Power Station which have been made in s.-g. iron. The second leaflet covers both normal Ni-Resist (flake-graphite type) and s.-g. Ni-Resist cast irons, whilst the third details a new

heat-resisting material for castings for service up to 950 deg. C. It is stated that this material retains proportionately higher strength-values than ordinary flake-graphite Ni-Resist up to the tested temperature of 700 deg. C., but with increased elongation. Loss-of-weight tests were carried out on this material in which specimens were maintained at a temperature of 950 deg. C. for two months. During this period, they were withdrawn from the furnace and cooled to room temperature each working day, thus accelerating the scaling action. In this sphere, the samples of Spheronic iron lost only 10 per cent. by weight, compared with 61 and 81 per cent. of s.-g. Ni-Resist and normal Ni-Resist respectively.

Refractory Coatings. A folder received from Corrosion, Limited, Warsash Road, Warsash, Southampton, describes a range of refractory washes and a refractory mortar carrying the trade name of Furnascote. These washes are stated to give "a brilliant glazed surface to even the roughest refractory" and a table is included giving the working temperature range of three types. A second material detailed gives a white matt surface, instead of a glaze. The properties of a mortar are also quoted. Instructions are printed for the proper use of these refractories and the claims for the advantages resulting from their use are set out.

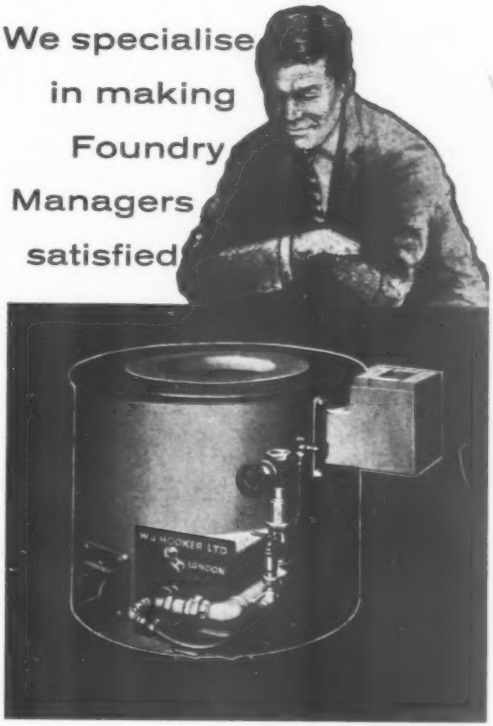
Non-ferrous Castings. A wide range of both copper-base and light alloys are covered in a catalogue recently issued by the 65-year-old Knowsley Cast Metal Company, Limited, Titan Works, Trafford Park, Manchester, 17. First, the mechanical properties are given for gunmetals, phosphor-bronze, leaded bronze, aluminium-bronze, high-tensile brass, high-conductivity alloys and nickel-containing alloys. For light alloys, the reader is referred to BS 1490-1955 which is complete and well known. Then follows a series of annotated illustrations, showing the application of various types of non-ferrous castings in industry. Finally, there is a page of notes on the design of castings.

Metal-spraying Equipment. Equipment and tools used for metal spraying, detailed in a six-page leaflet issued by Metallisation, Limited, Barclays Bank Chambers, Dudley, Worcs., were shown at the recent "Gas at Work in Industry" exhibition held in London. The leaflet issued by this company is a very interesting piece of publicity and indicates very clearly the wide potentialities of the process of metal spraying when properly carried out, using modern tools and equipment.

Conveyors. In catalogue No. LC-32-1, Thos. W. Ward, Limited, Albion Works, Sheffield, illustrate and describe a light-type of conveyor—often used as a portable length—known as Rolarail. The conveyor design is based on the principle of mounting small wheels so that they project a little over the upper flanges of a parallel girder section. This system is suitable for numerous applications in manufacturing and warehousing establishments.

Cable Trunking. In publication No. L.S. 4500, Lancashire Dynamo Nevelin, Limited, Hurst Green, Oxted, Surrey, describe and illustrate the Neviduct system of cable ducting, which includes easily-erected standardized parts, steel trunking units, used with what appear to be cast-aluminium accessories—tees, elbows, intersections, couplings, etc.

STANDARD BRASS IRON & STEEL FOUNDRIES, LIMITED—There is no interim dividend for the year to June 30, 1960 (6d. per 5s. share).



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American Letter

Microstructural Changes when tempering White Iron*

The alloy studied had the following nominal chemical composition in per cent. by weight: C 3.3; Si 0.5; Mn 0.5; Ni 4.5, and Cr 2.0. The hardness of this material normally is about 600 Bhn, and the microstructure consists of large amounts of massive carbide surrounding martensitic dendrites. Usually a significant amount of retained austenite is present in the as-cast condition.

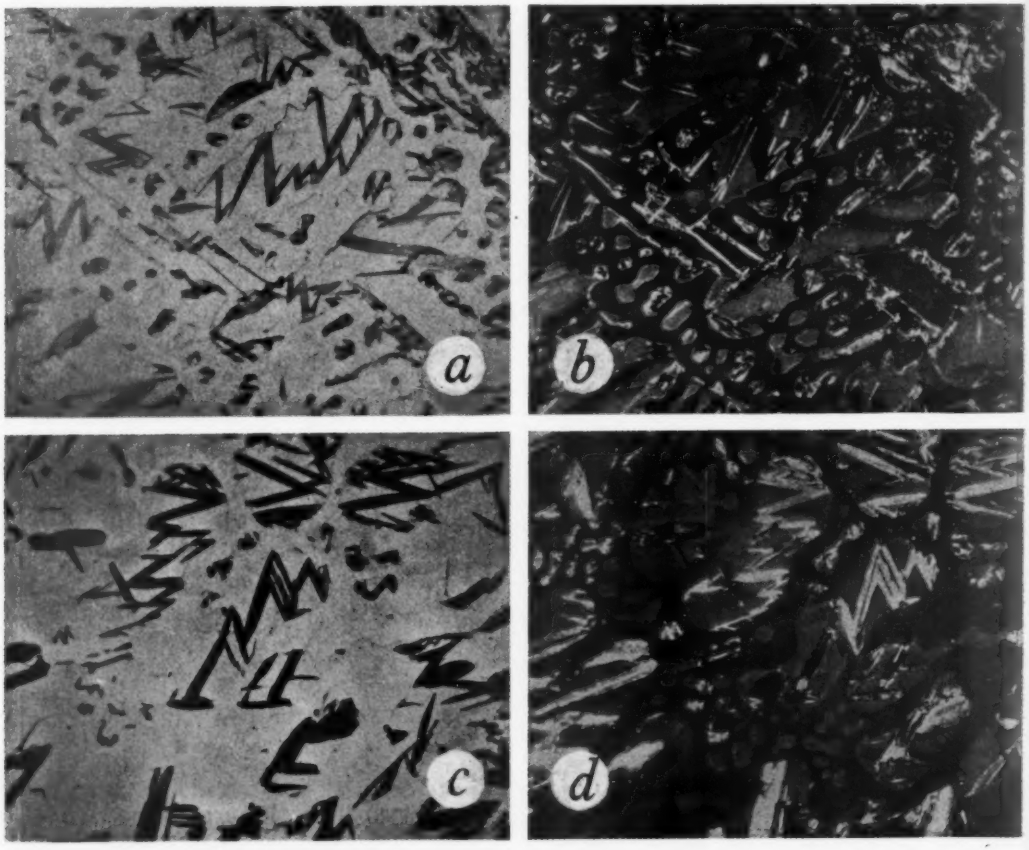
Different Appearance with Polarized Light

Since tempering of martensitic white-iron castings at 205 deg. C. had been found to be of considerable benefit to the mechanical properties, a brief study was made of the microstructural changes produced by this heat-treatment. No marked change in the microstructure could be seen at the magnifications possible with light microscopy, but when the etched microstructures were viewed under polarized light a marked difference in appearance was observed (see Fig. 1.) When the sample was rotated in relation to the plane of polarization of the light, the martensite plates in the tempered iron appeared alternately light and dark four times in one revolution, whereas the as-cast martensite plates remained dark in comparison.

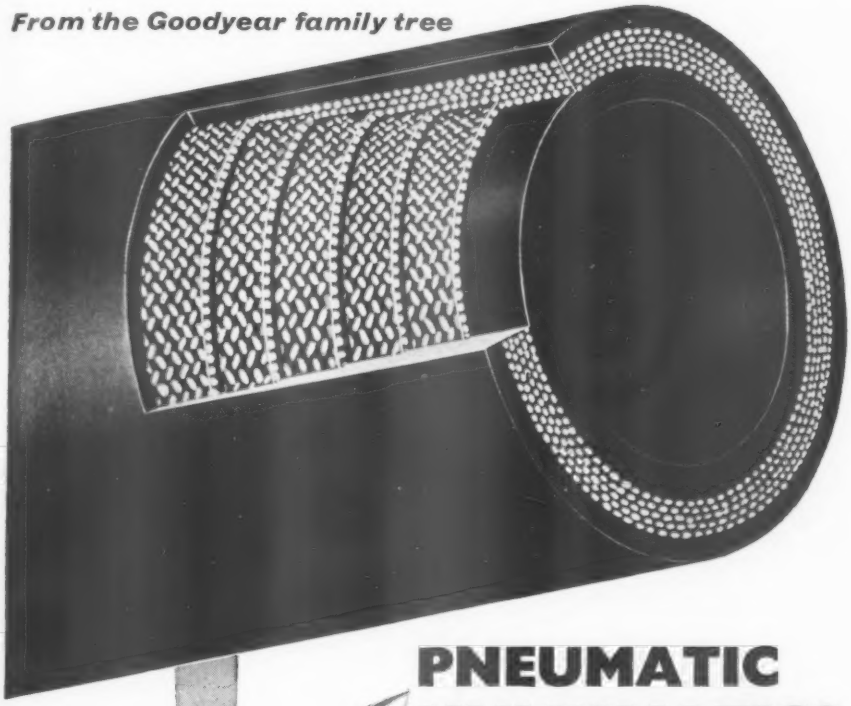
Tempering at 205 deg. C. for 5 hr. caused a lamellar precipitation of a second phase within the martensite plates. Small amounts of bainite formed from the retained austenite could also be seen in electron micrographs at ×5,500. Particles for identification of the lamellar phase were removed from the tempered martensite by an extraction technique. The observed spacings compared well with those of carbides in tempered low-carbon iron, which indicates that the tempering reactions in the white cast-iron are similar in behaviour to those in irons and steels. The increase in toughness is due to this precipitation of carbide, which allows the highly strained martensite to relax.

* Abstracted from a paper, by J. R. Mihalisin and R. D. Schelleng which is to be presented at the American Foundrymen's Society annual meeting, in May. The authors are associated with the research laboratory of International Nickel Company Incorporated, Bayonne, New Jersey.

FIG. 1.—*Etched photo-micrographs of Ni/Cr white iron: (a) and (b) as-cast, and (c) and (d) tempered at 205 deg. C. The right-hand photo in each case is the structure, at the same position of the specimen, viewed under polarized light, the as-cast martensite appearing dark, and the tempered martensite light.*



From the Goodyear family tree



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Company News

F. PERKINS, LIMITED, diesel-engine manufacturers of Peterborough—An interim dividend of £745,865 tax free is announced.

AUSTRALIAN ALUMINIUM COMPANY, LIMITED—Profits rose to £A468,000 (£A412,000) in 1959, and the ordinary dividend is doubled at 20 per cent.

J. & J. DYSON, LIMITED, manufacturers of refractory materials, etc., of Sheffield—All the ordinary capital of D. Duddell, Limited, Stoke-on-Trent, has been acquired.

ALEXANDER DUCKHAM & COMPANY, LIMITED—Net profits for 1959 were £91,456 (£72,475) and the dividend is 17½ (15) per cent. on a capital doubled by a scrip issue.

G. & J. WEIR HOLDINGS, LIMITED—Group net profits rose from £1,123,173 to £1,256,143 in 1959 and the dividend is raised to 18 (17) per cent., with a final of 12 per cent.

BRITISH ROLLMAKERS CORPORATION, LIMITED—The final dividend is 8 per cent., making 12 per cent. for the year to January 2, 1960, or the same equivalent as previously, adjusting for last May's one-for-four scrip issue. The net group profit is £429,836 (£467,016), after tax of £359,062 (£505,860).

CROFTS ENGINEERS (HOLDINGS), LIMITED, iron and steel and brassfounders, etc., of Bradford—Final dividend of 9¼ per cent. is being paid, making 16 per cent. for 1959, on capital increased by a one-for-four scrip issue—an effective increase of 2 per cent. After tax of £623,591 (£671,785), group net profit rose to £673,794 (£618,771).

H. BRAMMER & COMPANY, LIMITED, manufacturers of transmission belting, etc., of Leeds—The dividend is raised from the equivalent of 23¼ per cent. to 25 per cent., on capital increased by a one-for-two scrip issue, with a final of 17½ per cent. for 1959. Group profits were £249,039 (£193,914) and the net balance is £136,383 (£86,801), after tax of £112,656 (£107,113).

BIRMINGHAM RAILWAY CARRIAGE & WAGON COMPANY, LIMITED—The board, which recently received a merger offer from Charles Roberts & Company, Limited, Wakefield, reports lower earnings for 1959. The dividend is cut to 7½ (10) per cent., but is supplemented by a tax-free payment of 5 per cent. from capital profits. Net profit was £71,508 (£95,836), after tax of £69,042 (£79,042).

HENRY BALFOUR & COMPANY, LIMITED, ironfounders, gas and chemical engineers, etc., of Leven (Fife)—The dividend is raised by 1 per cent. to 18 per cent. for the year ended October 31, 1959. Recent months have shown a marked increase in the number of orders received from both overseas and home sources, states the chairman, Mr. W. Lindsay Burns. Group net profit increased to £92,124 (£75,013).

HARRISON (BIRMINGHAM), LIMITED—The dividend for the year ended December 31, 1959, is held at 9d., but the bonus is doubled at 3d. Profit, after tax, rose to £180,650 (£123,321). Increase of the authorized capital to £1,150,000 and the capitalization of £396,000 by the distribution of 1,584,000 ordinary 5s. shares as a bonus issue to holders will be proposed at an extraordinary meeting following the annual meeting on May 6.

NORTH BRITISH LOCOMOTIVE COMPANY, LIMITED—The chairman, Mr. T. Coughtrie, reports that orders at December 31, 1959, were just over £11,000,000. Export orders were particularly difficult. Everything possible was being done to revitalize the selling effort at home and overseas. The group incurred a loss of £1,349,566 in 1959, against a net loss of £909,512. The net loss attributable to the parent company was £1,319,541 (£911,827).

C. A. PARSONS & COMPANY, LIMITED, makers of steam turbines and electrical machinery, etc., of Newcastle-upon-Tyne—With a final of 5 per cent., the dividend is effectively raised by 1¼ per cent. to 9¼ per cent. The final a year ago of 3¾ per cent. was accompanied by a special interim of ¼ per cent. After tax of £1,269,575 (£1,240,454), and debiting £170,000 (£50,000) to contingencies reserve, net profit was £2,209,114 (£2,091,284).

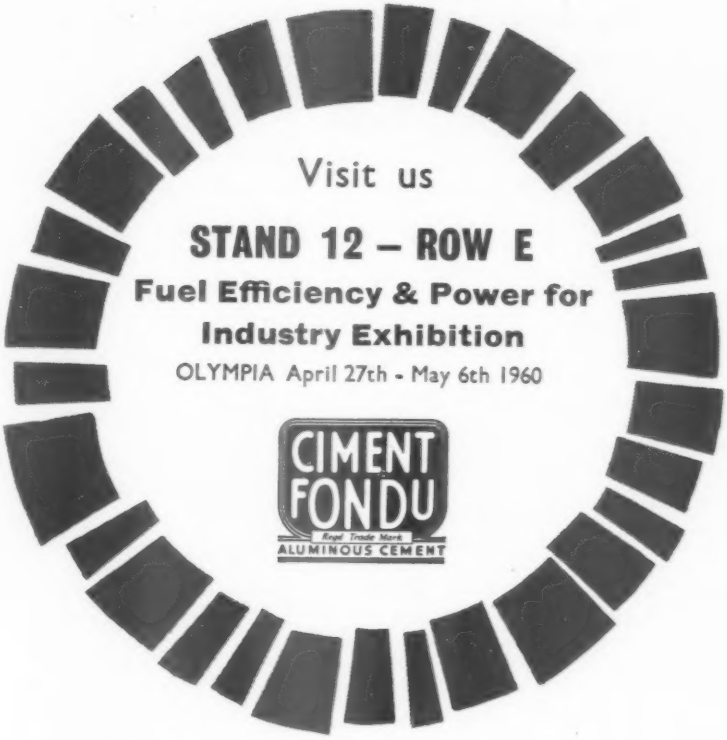
IMPERIAL CHEMICAL INDUSTRIES, LIMITED—The group's sales rose last year from £463,000,000 to £509,000,000 and group income, before tax, was up to the record figure of £73,100,000 (£44,500,000). A final dividend of 7½ per cent., against 5 per cent. a year ago, brings the payment for the year to 11¼ per cent., compared with 8 per cent. Under the company's profit-sharing plan £7,100,157 (£5,406,177) is set aside as employees' profit-sharing bonus.

TUBE INVESTMENTS, LIMITED—Approximately 99 per cent. of the 16,828,702 ordinary £1 shares provisionally allotted to ordinary holders at 25s. per share have been taken up. The issue was not underwritten, but Helbert Wagg & Company, Limited, and J. Henry Schroder & Company, Limited, have subscribed at the issue price for the shares not taken up. These shares will be sold and the net proceeds will be distributed among the holders whose rights were not taken up.

CLARKE, CHAPMAN & COMPANY, LIMITED, marine and electrical engineers, boilermakers, etc., of Gateshead—Depression of freights and the nervousness in laying down of new tonnage had resulted in a lack of orders for the company's marine equipment, said the chairman, Mr. J. B. Woodeson, at the annual meeting. In addition, the company was feeling the effect of economies exercized by the National Coal Board. He spoke of the difficulties concerning power-station plant which, due to modern designs, have resulted in larger units and in turn fewer orders being placed with those concerned with power-station equipment. The total result of these factors was that there would be a slight contraction in the turnover this year which, if matters worsen, could affect the company's results.

Review of ISCOR Activities

Net sales value of products sold by the South African Iron and Steel Industrial Corporation, Limited, during the last financial year was £47,610,168 says the chairman, Dr. F. Meyer, in his annual report. Net profit amounted to £7,560,974. During the year, the Corporation's iron-ore mines at Thabazimbi and Sishen respectively despatched 1,458,583 and 1,058,505 tons of ore to the two works at Pretoria and van der Bijl Park; in addition 6,427 tons of iron ore were sold to consumers in the Union. Steel production at 1,740,000 ingot tons was a record, and exceeded the previous year's output by 93,000 tons—an increase of just over 5½ per cent. Iscor's liquid-iron production for the year amounted to 1,660,336 tons. The value of export orders received has shown a considerable increase since the end of the year under review, says Dr. Meyer. Over the years the Corporation has secured orders involving more than 575,000 tons of iron and steel worth approximately £11,000,000, the biggest buyers being Japan, the USA, the Argentine, Soviet Russia, Pakistan and the United Kingdom in that order.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AP 95

Pig-iron and Steel Production

Statistical Summary of January Returns

The following particulars of pig-iron and steel produced in Great Britain are from statistics issued by the British Iron and Steel Federation. Table 1 summarizes activities during recent months. Table 2 gives production of steel ingots and castings in January. Table 3, weekly average production of finished steel in December. Table 4 gives the production of pig-iron and ferro-alloys in January, and furnaces in blast. (All figures are weekly averages in thousands of tons).

TABLE 1.—*Iron and Steel Index and General Summary of Pig-iron and Steel Production.*

Period.	B.o.T. Price Index, 1938 = 100.			Iron-ore output.	Imported ore used.	Coke sent to blast-furnaces.	Pig-iron, ferro-alloys prod.	Scrap used in steel prod.	Steel (incl. alloy).			
	Iron and steel.	Coal.	Basic materials[1]						Imports.[2]	Prod. ingots, castings.	Delivrs. finished steel.	Stocks.[3]
1957	328	488	537	325	308	270	275	220	14	417	322	2,480
1958	343	403	478	276	262	227	245	196	9	369	284	2,242
1959	340	497	477	286	244	210	242	208	7	388	291	2,244
1960—Jan. ..	339	508	489	322	306	255	298	246	11	471	354	2,347

TABLE 2.—*Average Weekly Production of Steel Ingots and Castings in January.*

District.	Open-hearth.		Bessemer.	Electric.	All other.	Total.		Total ingots and castings.
	Acid.	Basic.				Ingots.	Castings.	
Derbys., Leics., Notts., Northants, and Essex ..	—	4.8	17.0 (basic)	2.6	0.1	22.9	1.6	24.5
Lancs. (excl. N.-W. Coast), Denbighs., Flints., and Ches.	0.8	39.6	—	4.8	0.4	44.2	1.4	45.6
Yorkshire (excl. N.-E. Coast and Sheffield) ..								
Lincs.	—	52.7	—	—	0.1	52.7	0.1	52.8
North-East Coast	1.0	92.6	—	1.4	0.4	93.5	1.9	95.4
Scotland	1.4	44.6	—	2.8	—	46.9	1.9	48.8
Staffs., Shrops., Worcs., and Warwicks. ..	—	25.6	—	4.3	0.8	26.8	1.9	28.7
S. Wales and Monmouthshire	1.9	92.9	14.5 (basic)	0.9	0.1	109.9	0.4	110.3
Sheffield (incl. small tonnage in Manchester) ..	7.5	35.8	—	14.5	0.3	56.2	1.9	58.1
North-West Coast	—	—	6.4 (acid)	0.8	—	7.1	0.1	7.2
Total	12.6	386.6	37.9	32.1	2.2	460.2	11.2	471.4
December, 1959[4]	11.2	354.7	36.4	28.6	2.0	422.6	10.3	432.9
January, 1959	11.4	296.5	24.5	22.5	2.0	347.6	9.3	356.9

TABLE 3.—*Deliveries of New Non-alloy and Alloy Finished Steel*

Product.	1958.	1959.	1958.	1959.	
			Dec.[4]	Nov.	Dec.[4]
Non-alloy steel:					
Ingots, blooms, billets, and slabs[5]	4.6	5.1	6.3	6.6	5.1
Heavy rails ..	10.2	6.8	8.4	6.2	6.9
Sleepers	1.2	0.6	2.0	0.2	0.2
Fish-and sole-plates	0.7	0.4	0.3	0.2	0.4
Plates: (i) Over ¾ in.	29.6	24.8	22.2	28.7	26.5
(ii) Under ¾ in.	17.7	18.3	14.9	20.7	18.3
Other heavy prods.	41.8	41.2	26.4	53.9	48.8
Ferro-concrete bars	7.6	9.6	6.3	12.2	10.0
Wire rod	21.5	23.5	20.5	28.0	25.5
Arches, etc. ..	8.6	7.8	6.2	7.3	6.4
Other light sections	29.1	38.0	25.7	40.8	38.9
Bright steel bars ..	6.2	7.6	5.5	9.4	8.5
Hot-rolled strip ..	22.6	27.4	20.7	32.9	28.7
Cold-rolled strip ..	7.0	8.0	6.3	9.9	8.9
Sheets, incl. coated:					
(i) Hot rolled ..	10.6	11.8	8.7	13.8	12.1
(ii) Cold reduced	31.1	35.2	30.8	38.4	34.8
Tinplate:	18.7	20.9	19.1	23.5	22.3
Blackplate ..	0.8	0.7	0.7	0.9	0.7
Tubes up to 16 in.	19.0	20.6	17.2	26.2	22.1
Tube fittings, etc. ..	0.4	0.4	0.3	0.5	0.4
Tyres, wheels, axles	4.5	2.4	3.1	3.3	2.0
Forgings (excl. drop)	2.6	2.1	2.1	2.3	1.9
Steel castings ..	4.2	3.6	3.3	4.1	3.7
Tool steel, etc. ..	0.2	0.2	0.2	0.3	0.2
Total	300.5	312.0	257.2	370.3	333.3
Alloy steel	16.1	18.2	13.5	22.7	19.5
Total deliveries[6]	316.6	330.2	270.7	393.0	352.8
Add: Imported finished steel ..	7.0	7.1	3.6	9.6	8.1
	323.6	337.3	274.3	402.6	360.9
Deduct: Intra-industry conversion[7] ..	41.2	47.6	36.0	55.8	49.2
Total new material ..	282.4	289.7	238.3	346.8	311.7

TABLE 4.—*Production of Pig-iron and Ferro-alloys*

District.	Furnaces in blast.	Hematite.	Basic.	Foundry.	Forge.	Ferro-alloys.	Total.
Derbys, Leics, Notts, Northants, and Essex	18	—	24.8	22.7	0.3	—	47.8
Lancs (excl. N.-W. Coast), Denbighs, Flints, and Ches ..	6	—	21.4	—	—	0.9	22.3
Yorks (excl. N.-E. Coast and Sheffield)	—	—	—	—	—	—	—
Lincs	10	—	47.3	—	—	—	47.3
North-East Coast	16	2.1	62.3	—	—	—	64.4
Scotland	5	0.1	17.0	1.3	—	—	18.4
Staffs, Shrops, Worcs, and Warwicks ..	5	—	9.3	1.0	—	—	10.3
S. Wales and Monmouthshire	11	3.4	60.2	—	—	—	63.6
Sheffield	2	—	3.1	—	—	—	3.1
North-West Coast	8	16.5	1.2	1.3	—	1.3	20.3
Total ..	81	22.1	246.6	26.3	0.3	2.2	297.5
December, 1959[4]	81	21.0	230.8	25.7	0.8	2.1	280.4
January, 1959 ..	84	19.2	183.7	23.5	0.1	2.2	228.7

[1] Used in non-food manufacturing industries.

[2] Weekly average of calendar month.

[3] Stocks, mainly ingots and semi-finished, at the end of the year and months shown.

[4] Five weeks, all tables.

[5] Other than for conversion into any other form of finished steel listed.

[6] Includes finished steel produced in the UK from imported ingots and semi-finished steel.

[7] Material for conversion into other products also listed in this table.

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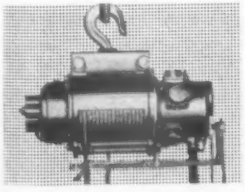

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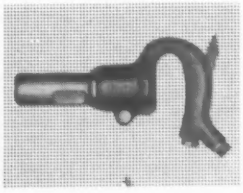

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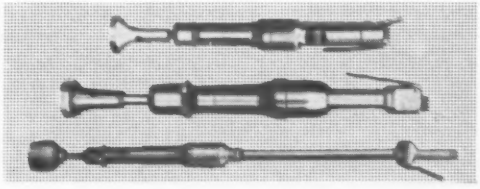

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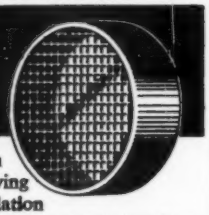

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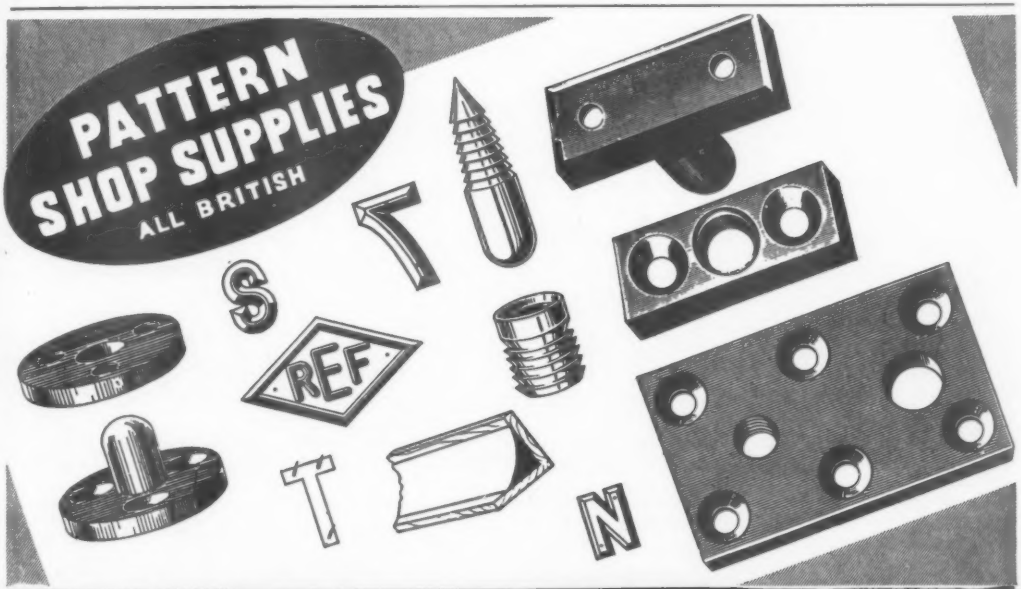

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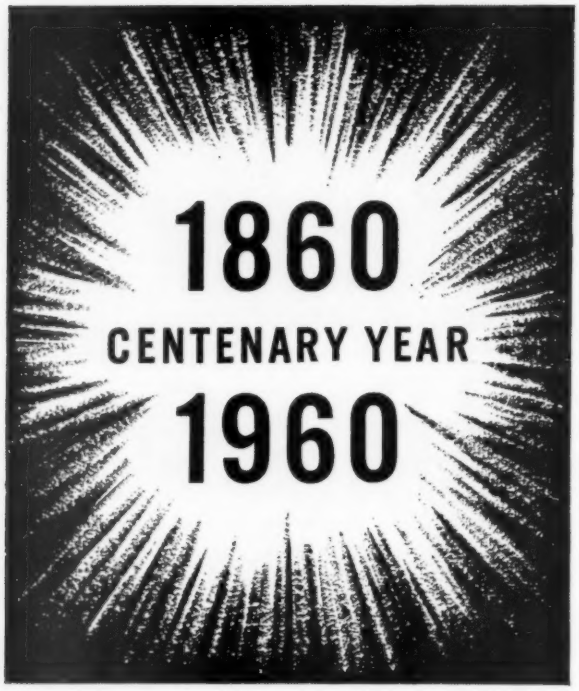

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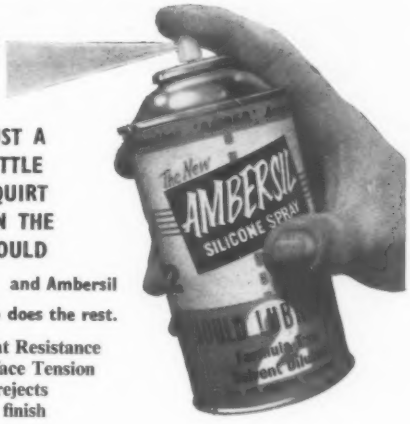

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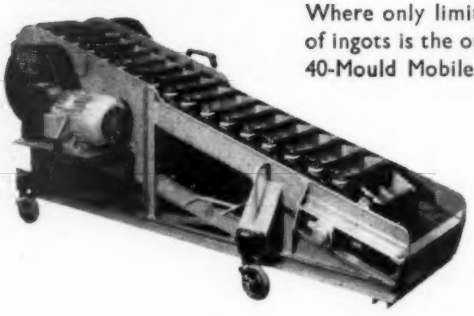

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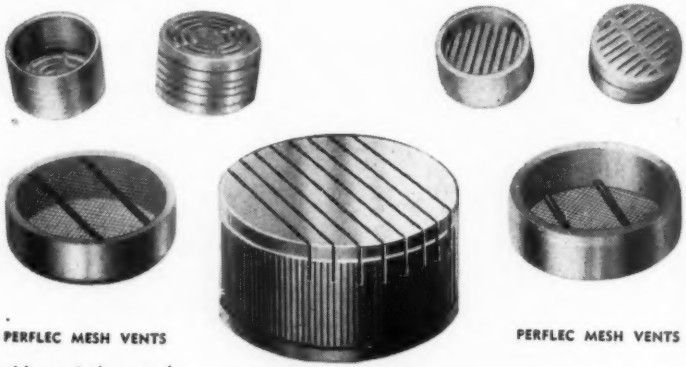

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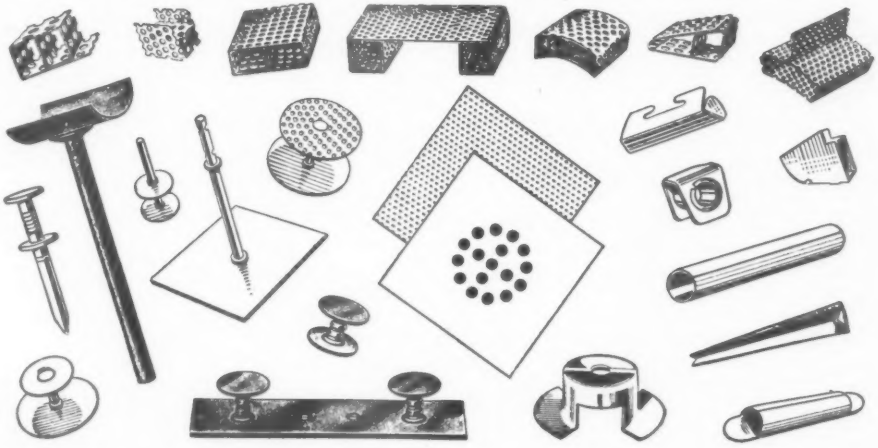

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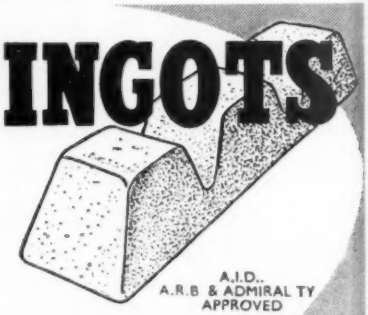

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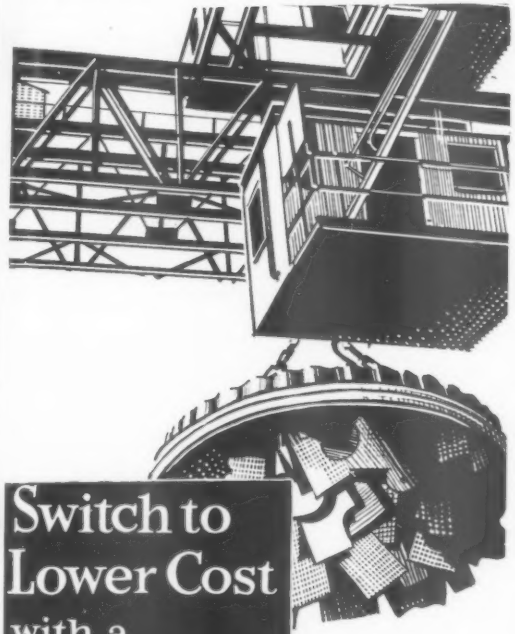

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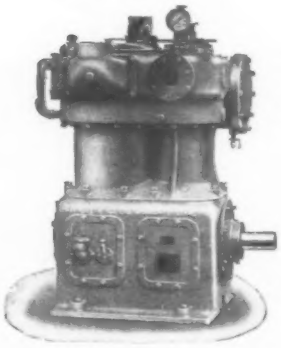

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August's, Ltd.	36
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Baker Perkins, Ltd.	445
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Bradbury, John, & Co. (Stockport), Ltd.	50
Bradley & Foster, Ltd.	—
British Acheson Electrodes, Ltd.	21
British Aero Components Ld.	—
British Electrical Repairs, Ltd.	—
British Foundry Units, Ltd.	14
British Industrial Sand Ltd.	—
British Iron & Steel Federation	—
British MonoRail, Ltd.	—
British Moulding Machine Co., Ltd.	30 & 31
British Oxygen Co., Ltd.	—
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British Shotblast & Engineering Co., Ltd.	—
Broadwell Engineering, Ltd	—
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Buckland Sand & Silica Co., Ltd.	—
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Busby Bros., Ltd.	—
Carborundum Co., Ltd.	—
Catalin, Ltd.	16
Cawood Wharton & Co., Ltd.	50
Ciba (A.R.L.), Ltd.	—
City Casting & Metal Co., Ltd.	48
Clayton Crane & Hoist Co.Ld.	—
Cohen, Geo., Sons & Co., Ltd.	—
Coleman-Wallwork Co., Ltd.	—
Combustion Chemicals, Ltd.	49
Consolidated Pneumatic Tool Co., Ltd.	443
Constructional Engineering Co., Ltd., The	32
Controlled Heat & Air, Ltd.	—
Cooke, Bailey, Ltd.	—
Cox & Danks, Ltd.	—
Crockett Lowe, Ltd.	—
Cumming, Wm., & Co., Ltd.	50
Cupodel, Ltd.	—
Dallow Lambert & Co., Ltd.	—
Derby & Co., Ltd.	—
Distillers Co., Ltd.. The	—
Distington Engineering Co., Ltd.	—
Dowler, H. J., Engineers & Pattern Makers, Ltd.	—
Dowson & Mason, Ltd.	—
Dunford & Elliott, Ltd.	—
Durrans, James, & Sons, Ltd.	8
Dustraction, Ltd.	—
Dustuctor Co., Ltd.	—
Electrical Development Assoc.	—
Elliott, E., & Co., Ltd.	—
Engineering Services (Manchester), Ltd.	—
Escol Products, Ltd.	24
Evans, James, & Co., Ltd.	—
Evans, Stanley N., Ltd.	—
Evershed & Vignoles, Ltd.	—
Eyre Smelting Co., Ltd.	51
F. & M. Supplies, Ltd.	—
Felco Hoists, Ltd.	—
Fellows & Darby, Ltd.	—
Fischer, George, Ltd.	—
Fisher-Foundries, Ltd.	—
Fletcher Miller, Ltd.	48
Flextol Engineering Co., Ltd.	—
Fordath Engineering Co., Ltd.	2
Foundry Equipment, Ltd.	10 & 11
Foundry Mechanisations (Baillot), Ltd.	6
Foundry & Metallurgical Equipment Co. Ltd.	17
Foundry Plant & Machinery Ltd.	19
Foundry Services, Ltd.	—
Foundry Suppliers, Ltd.	—
Foxboro-Yoxall, Ltd.	—
Franklin Furnaces, Ltd.	—
Fuel Efficiency & Power for Industry Exhibition	26
Fuel & Metallurgical Processes, Ltd.	22
Fullers' Earth Union, Ltd., The	53
G.W.B. Furnaces, Ltd.	—
Gadd, Thos.	—
Gas Council	—
General Refractories, Ltd.	3
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Guest, Keen Iron & Steel Co., Ltd.	28
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High Speed Steel Alloys, Ltd.	—
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Jacks, Wm., & Co., Ltd.	447
Joy-Sullivan, Ltd.	—
Keith-Blackman, Ltd.	—
King, Geo. W., Ltd.	—
Lafarge Aluminous Cement Co., Ltd.	453
Laidlaw, Drew & Co., Ltd.	—
Lazarus, Leopold, Ltd.	—
Leicester Lovell & Co., Ltd.	—
Levy, B., & Co. (Patterns), Ltd.	42
L.M.S. Products, Ltd.	—
Lones, Joseph Laboratories	—
Lord, E. S., Ltd.	—
Luke & Spencer, Ltd.	12
Macnab & Co., Ltd.	—
Major, Robinson & Co., Ltd.	—
Mansfield Standard Sand Co., Ltd.	—
Marco Conveyor & Engineering Co., Ltd.	—
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May, J. H., Ltd.	—
McKechnie Bros., Ltd.	26
Metalectric Furnaces, Ltd.	—
Metalline Cement Co., The	—
Metals & Equipment (Wolverhampton), Ltd.	—
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Midland Monolithic Furnace Lining Co., Ltd.	42
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Morris, B. O., Ltd.	—
Morris, H., Ltd.	—
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Newman Industries, Ltd.	—
Newton Collins, Ltd.	—
Newman Hender & Co., Ltd.	—
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Norris Equipment & Construction, Ltd.	—
Ormerod, R. E., Ltd.	—
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Parkinson Cowan Industrial Products	—
Passe, J. F., & Co.	—
Paterson Hughes Engineering Co., Ltd.	—
Patterncrafts, Ltd.	43
Pearson, E. J. & J., Ltd.	44
Peco Machinery Sales, Ltd.	—
Perry, G., & Sons, Ltd.	43
Phillips, J. W. & C. J., Ltd.	447
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Refined Iron Co. (Darwen), Ltd.	—
Reid, Wm., & Co.	43
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Richardsons, R. J. & Sons Ltd.	—
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Riley (I.C.) Products, Ltd.	33
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Rowland, F. E., & Co., Ltd.	—
Rownson (Conveyors), Ltd.	—
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Spermolin, Ltd.	—
Stansby, W., & Co., Ltd.	42
Stanton Ironworks Co., Ltd., The	—
Staveley Iron & Chemical Co., Ltd.	—
Steels Engineering Installations	—
Stein, John G., & Co., Ltd.	—
Sterling Foundry Specialties, Ltd.	34
Sternol, Ltd.	18
Stott, S. S., Ltd.	—
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Waring Bros.	40
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Warrington Red Sand	—
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Wright & Platt, Ltd.	42

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